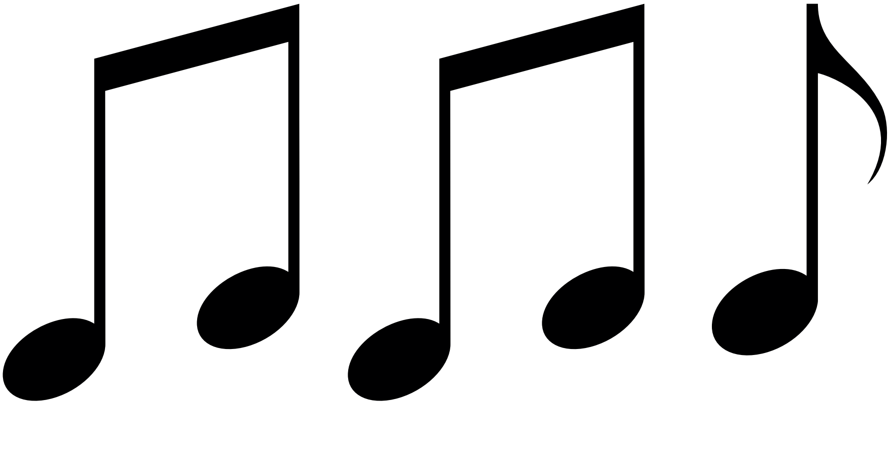
Autistic Études



Alan Griswold

Autistic
Études

Autistic Études

Alan Griswold

iUniverse®

AUTISTIC ÉTUDES

iUniverse
1663 Liberty Drive
Bloomington, IN 47403
www.iuniverse.com
844-349-9409

ISBN: 978-1-6632-6807-5 (sc)
ISBN: 978-1-6632-6808-2 (e)

Library of Congress Control Number: 2024922134

iUniverse rev. date: 10/22/2024

Contents

Preface

The essays in this volume are a bit unusual for me. First of all, they are written in the style of scholarly articles (although they are not in fact scholarly articles at all, as I will explain shortly). Furthermore, these essays introduce only a little in the way of new ideas, covering much the same ground as my previous writings, especially the most recent work, *Autistic Rhapsody*. When I had finished *Autistic Rhapsody*, I thought that I was done, having in that book gathered, summarized, and connected almost every concept I had ever had regarding the topics of human behavioral modernity, intelligence, autism, evolution, and so on. There really did not seem to be anything else for me to say.

But apparently I was not done—and thus here we are.

I think what has compelled me to go on is a deep sense of dissatisfaction with the current state of the scholarly world, a dissatisfaction that has been gnawing at me over the years and which I believe needs to be more widely felt and addressed. At first glance academia and research have never been more booming. Formerly the domain of a handful of eccentrics and recluses, the scholarly world today employs millions upon millions of established professionals, easily recognizable both by their requisite credentials and by their prodigious outpourings of words and statistics. The number of academic journals has multiplied over the past several decades to the point of now being nearly countless, and the number of published articles has been increasing exponentially across nearly every field. And the number of citations and co-authors within those published articles...well, oh my! Let us just say that if you are a scholarly professional who has not been cited at least five hundred times by mid-career, then you are clearly failing in your academic and collegial efforts. Grants, stipends, awards, fellowships—these too have been mushrooming by leaps and bounds, with the success of scholarship today measured not just by number of citations but also by the accumulation of dollars and euros snagged for one's respective institution. The graduate schools are brimming with would-be hopefuls, some of whom will unfortunately—albeit necessarily—become part of the grist that feeds the system, but others of whom, if they behave and follow the rules, will eventually be invited to join the vested collective, adding yet one more layer to its impressive girth. Have little doubt about it, the scholarly world today is not just a bustling enterprise, it is also a well-oiled and gargantuan machine.

But there is something clearly amiss with that machine, for in the annals of history I doubt there has ever been so much effort expended at producing so little. Oh, sure, if you are totaling words, confidence intervals, and obsequious references, then the scholarly world today is now full to overflowing. But if you are totaling useful human insights, then the scholarly world today has become as bankrupt as any other Ponzi scheme. To see this, one need only hearken back to the days of Einstein, Darwin, Heisenberg, Maxwell, Cantor, Turing—a time when the scholarly world was minuscule by way of comparison to its current range, and yet that minuscule world managed to produce a long list of valuable and revolutionary understandings, understandings that literally changed the course of human existence and human endeavor. Now judge what has been happening over the last fifty years or so, a period of time during which the academic and research communities have enlarged by several orders of magnitude from their former days. Have the insights *also* been enlarging by several orders of magnitude? In fact, the number of useful human insights, far from increasing, have actually been *decreasing* by several orders of magnitude across that time. Ask yourself, have any ideas or concepts emerged over the past half century or so that can compete with the impact of relativity, evolution, quantum theory, computation, and so on? I cannot think of a single thing. And ask yourself, has any illustrious professor emerged from today's scholarly mass who might be deemed worthy of inclusion alongside that list of brilliant names from above? I cannot think of a single soul. Despite all the heat and hubbub emanating from its current expanse, the most salient fact about the scholarly world today is that it has gone bust.

I consider myself rather blessed, because I have never been a part of that scholarly world. To it, I am merely an insignificant outsider, which is a mutually agreeable arrangement. This is why these essays, although written in the style of scholarly articles, cannot be considered as actual scholarly work. To begin with, their author does not possess the requisite credentials—I have never paid the necessary post-doctorate dues. Furthermore, I have not attached to these works the names of many co-authors, those well-connected colleagues who might prove useful in easing entry past the more truculent publishing gates. And the citations I have chosen to include within these articles…well, oh my! Let us just say they are entirely inadequate, both in number and in their failure to pay proper homage to the more prominent and trendy figures from the relevant fields. Indeed, a good many of these citations, far from being meant to curry favor, are intended exclusively to tease and to shame. In addition, these works do not follow the standard and prescribed form, their sub-headings and line of discussion geared more towards cogency than conformity. And finally, and perhaps most importantly of all, these works do not give due deference to any popular and prevailing views, indeed just the opposite, unabashedly wielding a sledgehammer against nearly every conventional notion to be found within the topics of human behavioral modernity, intelligence, autism, evolution, and so on. Many things might be said about the essays in this volume, but the one thing that cannot be said is that they are examples of modern scholarship.

So why have I bothered? Why have I made the effort to write essays in the style of scholarly articles? I guess the short answer to that question is that I have done this to prove a point, the point being that useful human insights can still be presented outside the scholarly world, outside the stifling restrictions of requisite credentialship, authorship multiplicity, citation back scratching, and intellectual conformity, with a further point being made that it has been the insistence upon these odious practices that has been the source of the scholarly world's current state of bankruptcy. But you need not rely upon the essays in this volume for the making of that point (time can sort out whether that would make for a reasonable choice). Instead, consider this. Arguably the most important and influential scholarly work ever to have been penned was a paper submitted to and published by the journal *Annalen der Physik* in the summer of 1905, a paper entitled *On the Electrodynamics of Moving Bodies*. There are some unusual things to note about that paper. For one, it contains not a single citation, obsequious or otherwise. Two, the paper has only one author, and furthermore, that author is not a well-credentialed and well-connected physics professor, but is instead a twenty-six-year-old patent office clerk. And in keeping with that author's humble line of employment, the form of the paper is not that of a scholarly article, even by the looser standards of that earlier day, but is instead written in the form of a patent application, something with which the author must have felt more at home. And finally, and perhaps most importantly of all, the paper gives nothing in the way of fawning deference to the prevailing scientific views of that day, indeed just the opposite, choosing to ruthlessly smash every one of those views into little tiny bits. I shudder to think how such a paper might be treated at the editorial hands of the academic journals today.

There will still be useful human insights—the truth always must out. But it can be expected that very few of those insights will emerge anytime soon from the scholarly world, too entangled inside its ever-enlarging chains. This means that by necessity such discoveries will fall to the insignificant outsiders, those less numerous souls not constrained by elitism, collusion, and convention, those eccentrics and recluses free to follow their individual acumen wherever and however that acumen might lead. Who knows, one day there might even be found some useful human insights in the form of a volume of essays written in the style of scholarly articles.

Rethinking the Flynn Effect

Abstract

Since its discovery, the Flynn effect has been the target of a general unease that has been manifested within the research literature in various guises, including a dismissiveness of the phenomenon's significance, an overfitting by complex models, and a bias towards the Flynn effect's anticipated end. Ironically, one approach *not* considered by the research community has been to embrace the Flynn effect as valid, fundamental and enduring. This exclusion will prove to be a mistake, because a simple analysis demonstrates that the Flynn effect has been operative within the human species throughout much of human history, ever since the turn towards behavioral modernity, and as a consequence, the Flynn effect has a great deal new to tell researchers about human intelligence today.

1. Introduction

During the twentieth century, several researchers noticed that overall raw performance on intelligence exams seemed to be generally increasing over time. Then it was James Flynn in the 1980s who provided abundant evidence that this phenomenon was essentially universal, thereby drawing greater attention to it, and the phenomenon would eventually be dubbed the Flynn effect (Flynn, 1984, 1987). Since its discovery, the Flynn effect has remained a scientific mystery, an unexpected result defying the many attempts to explain it (Trahan et al., 2014). And perhaps due in part to this intransigence, the Flynn effect has also been the target of an unease and mistreatment, everything from an initial dismissiveness of the phenomenon's significance by James Flynn himself, to an ongoing tendency towards overfitting by models distinguished for their parameterized complexity, to a more recent groundswell of anticipation for the Flynn effect's apparently imminent and necessary demise.

Ironically, the one approach to the Flynn effect that seems not to have been given any serious consideration by the intelligence research community has been to embrace the phenomenon as a fundamental and enduring property of human intelligence, as consequential in impact as say Spearman's *g* (general intelligence ability). This neglect will prove to be a mistake. Afforded a reasonable degree of presumptive acceptance, the Flynn effect emerges as not a twentieth-century aberration, and not a temporary quirk to be solved with labored explanations. Instead, the Flynn effect can be demonstrated as having been with humanity for an extremely long period of time, ever since the beginning of the human behavioral transformation, and therefore there is no reason to expect that the Flynn effect will end anytime soon. Far from being a candidate for unease and mistreatment, the Flynn effect needs to be recognized as foundational to a complete understanding of human intelligence.

2. Various Forms of Dismissal

In reading through the intelligence research literature, one seldom comes across the Flynn effect being described with such terms as *foundational*, *fundamental* or *permanent*. Instead, the words *aberration*, *not real* and, above all else, *temporary* are more frequently applied. One of the earliest attacks on the Flynn effect came from James Flynn himself, who having inferred that the IQ gains he was seeing in the data would apparently classify his nineteenth-century ancestors as mentally deficient and would render today's children as observably smarter than their parents, opined that the Flynn effect was not indicative of a true increase in human intelligence (Flynn, 1987, 1998, 2007).

Flynn would later waver in this opinion, eventually devoting many articles and entire books to exploring the Flynn effect as a serious topic for human intelligence (Flynn 2007, 2012), even going so far as to collaborate with William Dickens to develop a labyrinthine model for explaining how the Flynn effect can be reconciled to the *g* of general intelligence ability (more on the Dickens-Flynn model in a moment). Nonetheless, throughout his career, Flynn never seemed to come to peace with his namesake subject, remaining confused by its apparent paradoxes and troubled by its disruptive implications. In this, Flynn was certainly not alone. Unease with the Flynn effect is practically palpable within the literature, almost the entirety of which can be summed up in the following manner:

1. The Flynn effect is puzzling and unexpected, to the point of being surely an aberration.
2. The Flynn effect began likely sometime during or just before the twentieth century, and certainly no earlier than the Scientific and Industrial Revolutions.
3. The Flynn effect cannot go on forever.
4. Therefore, there must be a cause (or a set of causes) that both explains how the Flynn effect recently came into being, and how the Flynn effect will of necessity soon go away.

The list of suggested causes is nearly endless—heterosis, better nutrition, expanded education—to name just a few (Mingroni, 2007; Lynn, 1989; Baker et al., 2015). But the problem has always been that these suggestions lack sufficient spatial and temporal reach to match the nearly ubiquitous impact of the Flynn effect. Thus, unable to explain the phenomenon easily, intelligence researchers have turned to two alternative approaches. The first approach has been simply to wait out the Flynn effect, to begin looking for the signs of its predicted and apparently requisite end. And perhaps not coincidentally, no sooner has this strategy been adopted than the evidence has begun to pour in supporting the anticipated result, even to the point of considering online surveys as evidence for the Flynn effect's reversal (Pietschnig & Gittler, 2015; Dutton, van der Linden & Lynn, 2016; Dworak, Revelle & Condon, 2023).

The second approach has been to subdue the Flynn effect with complexity and multiplicity. There have been three prominent attempts along these lines. The first has been the multiple causation theory (Jensen, 1998), the suggestion that although no one cause by itself can produce the Flynn effect, many causes in combination can adequately do the trick (in essence, *everything* causes the Flynn effect). The second attempt has been the Dickens-Flynn model (Dickens & Flynn, 2001), a complex gathering of mathematical formulae and parameterized concepts—social multipliers, rolling triggers, amplified feedback loops—all tunable to whatever IQ data one might happen to obtain. Indeed, Dickens and Flynn were known to tout their model's ample knobs and levers as one of its primary virtues (Dickens & Flynn, 2002). The third attempt has been the life history model of intelligence (Woodley, 2012), a conceptually intricate collection of statistically representable life history speed factors—such as pathogen stress, nutrition, family size, education, etc. These life history speed factors could presumably, and in just the right combination, produce the Flynn effect, and then in a different combination make it disappear.

The problem with this second approach is the concept known as overfitting. It is well understood within the practice of data science that given enough complexity and/or enough free parameters, a model can always be developed that will fit snuggly to any given set of data (Hawkins, 2004). Unfortunately, such models thereby lose all their explanatory and predictive power, rendering them empty of consequence. The multiple causation theory, the Dickens-Flynn model, and the life history model—these are all classic examples of overfitting. They tell us everything we could possibly want to know about the data, but leave it problematic as to whether they are saying anything insightful about human intelligence itself.

3. Human History and the Flynn Effect

The notion that the Flynn effect is only a recent phenomenon is contradicted by the entire course of human history. Although it is not exactly certain when the human species first began its turn towards behavioral modernity, any reasonable estimate would put this moment at no earlier than a few hundred thousand years ago (Henshilwood & Marean, 2003), and until that time, the human species was pure animal. Not a single concept to be found on a modern intelligence exam would have been present within the species—no language, no arithmetic, no geometric patterns, no logic, no anything. Try to imagine administering Wechsler to one of those ancient humans—it would have been no more successful than administering Wechsler to a wild leopard. But this means that measurable human intelligence was at that time quantifiable as absolute zero, and since measurable human intelligence today has clearly advanced to a more substantive number, that overall increase, *by definition*, is a Flynn effect. Indeed, it is a *massive* Flynn effect.

Furthermore, the increase in measurable intelligence over that time has been continuous and not sudden. For instance, by the time of the out-of-Africa hunter-gatherers, the human species had begun to display an observable degree of intelligence—controlled fire, crafted weapons, ornamental jewelry, cave paintings, etc. (Klein, 2002). Administering an intelligence exam to that population would have been conceivable, although the contents of such an exam would have needed to be simple and crude by modern standards, because of limited vocabulary, primitive numeracy, etc. Sometime later, by the era of the early farmers of the Fertile Crescent, a more advanced level of intelligence had become apparent within the species—permanent abodes, irrigation techniques, pottery making, etc. (Christian, 2018)—and an intelligence exam appropriate for that population would have been more sophisticated and more varied than the one appropriate for the hunter-gatherer population; and yet, such an exam would have had to remain simple by modern standards, because writing and arithmetic, for instance, were still on the verge of being invented. It has only been through recent times, an era increasingly dominated by such artifacts as books, cities and automobiles, that humans have gained enough proficiency to allow them to tackle the complexities of Stanford-Binet and Wechsler. Thus, the current level of measurable human intelligence has not come into existence suddenly, but instead has been steadily progressing ever since the first days of the human turn, and this means that the Flynn effect has been operative within the human population for a very long time.

And although conceptualizing intelligence exams for ancient populations does require some imaginative reasoning, do note that this reasoning remains entirely consistent with what actually took place during the twentieth century, on actual intelligence exams. The only way that an average IQ test taker from the early twentieth century could have equaled the raw score of an average IQ test taker from the late twentieth century would have been for the later exams to be altered to be more varied, more complex and more difficult (which, in many instances, they actually were). Increasing sophistication in the contents of intelligence exams is a palpable indicator of a progressive increase in the overall level of a population's measurable intelligence, an increase that was observably evident throughout the twentieth century, and is demonstrably evident over the course of human history, ever since the beginning of the human behavioral transformation.

But if this is indeed so, then it also puts to rest any notion that the Flynn effect is ending or reversing. What an incredible coincidence it would be to come across a phenomenon operative within the species for tens of thousands of years, and then now suddenly, right at the very moment of its conscious discovery, the phenomenon screeches to an abrupt halt. That would make no sense at all. Whatever has been driving the Flynn effect over the course of human history, including right through the entirety of the twentieth century, it must still be operative within the human population today.

4. A Model of Acceptance

In other works (Griswold, 2017, 2023; *A Field Theory of Human Intelligence*, in this volume), this author has outlined a model of human intelligence that accepts the Flynn effect as valid, fundamental and enduring. This model rejects the notion of intelligence being primarily a brain-centered and brain-specific characteristic, instead highlighting the amount of artificial construction and artificial complexity accruing within the human environment as the ultimate source of an increasing human intelligence. A list of the model's salient features would include the following:

1. Measurable human intelligence, as represented by the raw scores on intelligence tests, is best explained as the orthogonal product of two different factors: one, individual general intelligence ability (such as that quantifiable by *g*); and two, the total amount of

artificial construction contained within the human environment, the target towards which general intelligence ability is applied.

2. The contents of an IQ exam are themselves artificial constructions—words, digits, sequences, puzzles, matrices, etc. As such, they serve as a *proxy* for the artificial construction contained within the human environment. That is, an individual's performance on an IQ exam is an indirect assessment of that individual's ability to navigate and to master the artificial construction to be found in that individual's everyday world.
3. The overall level of general intelligence ability remains stable within the population over time. This is exactly as to be expected for an ability driven primarily by genetic and neural characteristics.
4. On the other hand, the amount of artificial construction contained within the human environment has been continuously increasing ever since the beginning of the human behavioral transformation. Humans have progressed steadily and successfully from living in an entirely natural setting to living in a world now dominated by accruing amounts of artificial construction.
5. Since measurable human intelligence is the orthogonal product of these two different factors (one, general intelligence ability, and two, the total amount of artificial construction contained within the human environment), one factor of which has remained stable over time and the other factor of which has been continuously increasing over time, measurable human intelligence has also been continuously increasing over time. This is a precise description of the Flynn effect, and it marks the accruing amount of artificial construction contained within the human environment as the sole driver and the sole explanation of the Flynn effect.
6. The above statements demonstrate that there is nothing contradictory or paradoxical about a stable general intelligence ability coexisting with increasing levels of measurable intelligence. Our nineteenth-century ancestors were not mentally deficient, nor are today's children smarter than their parents, because general intelligence ability remains stable over time. Nonetheless, later generations, by virtue of living in environments containing

increased levels of artificial construction, and by applying their general intelligence ability to those additional amounts of artificial construction, will thereby demonstrate greater levels of performance on intelligence exams.

7. The above statements also demonstrate that the widespread presumption that intelligence is primarily a function of the human brain is essentially incorrect. The brain plays a role—by being responsive to artificial construction—but the locus of intelligence is to be found in the expanding structure of the artificial environment, and not inside the neurons of the human brain.
8. Since the contents of IQ exams serve as a proxy for the artificial construction contained within the human environment, and since the amount and type of that artificial construction is continuously changing over time, the contents of IQ exams must themselves be adjusted on a regular basis, typically towards greater variety, greater complexity and greater difficulty, to reflect the growing challenge humans must face in navigating the increasing amounts of artificial construction contained within their surrounding world.
9. Barring a catastrophe (such as civilization collapse), the amount of artificial construction within the human environment will continue to increase into the foreseeable future, and future generations will be obliged to navigate and to master this increasing amount of artificial construction, and will thereby also go on to demonstrate increasing levels of performance on future intelligence exams. Therefore, there is no reason to expect that the Flynn effect will end anytime soon.

To characterize this model succinctly, it is best to say that it is an effort to employ the Flynn effect to challenge the preconceptions surrounding human intelligence, as opposed to an application of the preconceptions surrounding human intelligence to wrestle the Flynn effect into submission.

5. Conclusion

From the history of science, there is an analogous circumstance to that of the current situation regarding the Flynn effect. In the late nineteenth century, the Michelson-Morley experiment was conducted in order to detect the presence of the luminiferous ether, by measuring the difference in the speed of light in the direction of Earth's motion versus the speed of light at right angles to that motion (Michelson & Morley, 1887). But the result of the experiment turned out to be entirely unexpected, with the speed of light measuring the same in every direction observed. Scientists spent the next twenty years flailing against this result, first with insistence that the experiment was flawed, and then with later implication that the verified outcome was incomprehensible or inconsequential or both (Swenson, 1970). On a different front, by around the year 1905, Hendrik Lorentz and Henri Poincaré had worked out the complex mathematics needed to reconcile a stationary ether to the presumed spatial and temporal contractions experienced by moving bodies, equations and models derived specifically to fit to the Michelson-Morley results (Lorentz, 1904; Poincaré, 1900). But as with all cases of overfitting, what the Lorentz/Poincaré equations and models revealed was only information about the data itself, not providing any useful elucidation about the processes *underlying* that data.

So how was this circumstance resolved? It was resolved when a naive young gentleman dared an approach that had eluded the scientists of that day, namely accepting the Michelson-Morley outcome as both valid and fundamental, postulating that the speed of light was indeed the same in every inertial frame, and then working out the consequences from there. Everyone should be encouraged to read Einstein's original paper on special relativity—it is a paradigm of simplicity and straightforwardness (Einstein, 1905). And because Einstein's approach was so simple and straightforward, it retained its predictive and explanatory power, unveiling a host of compelling insights into the characteristics of space, time, matter and energy.

There is good reason to expect that a similar fate awaits the Flynn effect. When researchers come to accept the phenomenon as valid, fundamental and enduring (which perhaps requires a certain amount of naiveté), they will have the context for a model of human intelligence not encumbered by too much parametric complexity. And as with all simple and straightforward models, this one will retain some of its predictive and explanatory force, perhaps unveiling useful insights into the course of human history and into the nature of human intelligence.

References

Baker, D. P., Eslinger, P. J., Benavides, M., Peters, E., Dieckmann, N. F., & Leon, J. (2015). The cognitive impact of the education revolution: A possible cause of the Flynn Effect on population IQ. *Intelligence, 49,* 144–158. https://doi.org/10.1016/j.intell.2015.01.003

Christian, D. (2018). *Origin story: a big history of everything.* First edition. New York, Little, Brown and Company.

Dickens, W. T., & Flynn, J. R. (2001). Heritability estimates versus large environmental effects: the IQ paradox resolved. *Psychological review*, *108*(2), 346–369. https://doi.org/10.1037/0033-295x.108.2.346

Dickens, W. T., & Flynn, J.R. (2002). The IQ paradox: still resolved. *Psychological Review, 109*, 764-71.

Dutton, E., van der Linden, D., & Lynn, R. (2016). The negative Flynn Effect: A systematic literature review. *Intelligence, 59,* 163–169. https://doi.org/10.1016/j.intell.2016.10.002

Dworak, E. M., Revelle, W., & Condon, D. M. (2023). Looking for Flynn effects in a recent online US adult sample: Examining shifts within the SAPA Project. *Intelligence, 98.* https://doi.org/10.1016/j.intell.2023.101734

Einstein, A. (1905). On the Electrodynamics of Moving Bodies. *Annalen der Physik, 17*, 891-921.

Flynn, J. R. (1984). The mean IQ of Americans: Massive gains 1932 to 1978. *Psychological Bulletin, 95*(1), 29–51. https://doi.org/10.1037/0033-2909.95.1.29

Flynn, J. R. (1987). Massive IQ gains in 14 nations: What IQ tests really measure. *Psychological Bulletin, 101*(2), 171–191. https://doi.org/10.1037/0033-2909.101.2.171

Flynn, J. R. (1998). IQ gains over time: Toward finding the causes. In U. Neisser (Ed.), *The rising curve: Long-term gains in IQ and related measures* (pp. 25–66). American Psychological Association. https://doi.org/10.1037/10270-001

Flynn, J. R. (2007). *What is intelligence?: Beyond the Flynn effect*. Cambridge University Press.

Flynn, J. R. (2012). *Are we getting smarter? Rising IQ in the twenty-first century.* Cambridge University Press. https://doi.org/10.1017/CBO9781139235679

Griswold, A. (2017). *Concerto for Intelligence*. iUniverse. (accessible online: https://www.grizzalan.com/concertoforintelligence)

Griswold, A. (2023). *Autistic Rhapsody*. iUniverse. (accessible online: https://www.grizzalan.com/autisticrhapsody)

Hawkins D. M. (2004). The problem of overfitting. *Journal of chemical information and computer sciences, 44(1*), 1–12. https://doi.org/10.1021/ci0342472

Henshilwood, C. S., & Marean, C. W. (2003). The Origin of Modern Human Behavior: Critique of the Models and Their Test Implications. *Current Anthropology, 44*(5), 627–651. https://doi.org/10.1086/377665

Jensen, A. R. (1998). *The g factor: The science of mental ability*. Praeger Publishers/ Greenwood Publishing Group.

Klein, R. (2002). *The Dawn of Human Culture*. New York: Wiley.

Lorentz, H. A. (1904). Electromagnetic phenomena in a system moving with any velocity less than that of light. *Proc. Acad. Science Amsterdam*, IV, 669–78.

Lynn, R. (1989). A nutrition theory of the secular increases in intelligence; positive correlations between height, head size and IQ. *British Journal of Educational Psychology, 59(3)*, 372–377. https://doi.org/10.1111/j.2044-8279.1989.tb03112.x

Michelson, A. A, & Morley E. M. (1887). On the relative motion of the Earth and the luminiferous ether. *American Journal of Science, 34(203)*, 333–345.

Mingroni, M. A. (2007). Resolving the IQ paradox: Heterosis as a cause of the Flynn effect and other trends. *Psychological Review, 114*(3), 806–829. https://doi.org/10.1037/0033-295X.114.3.806

Pietschnig, J., & Gittler, G. (2015). A reversal of the Flynn effect for spatial perception in German-speaking countries: Evidence from a cross-temporal IRT-based meta-analysis (1977–2014). *Intelligence, 53,* 145–153. https://doi.org/10.1016/j.intell.2015.10.004

Poincaré, H. (1900). The theory of Lorentz and the principle of reaction. *Archives neerlandaises*, V, 252-78.

Swenson, L. S. (1970). The Michelson-Morley-Miller Experiments before and after 1905. *Journal for the History of Astronomy*, *1*(1), 56–78. https://doi.org/10.1177/002182867000100108

Trahan, L. H., Stuebing, K. K., Fletcher, J. M., & Hiscock, M. (2014). The Flynn effect: a meta-analysis. *Psychological bulletin*, *140*(5), 1332–1360. https://doi.org/10.1037/a0037173

Woodley, M. A. (2012). A life history model of the Lynn-Flynn effect. *Personality and Individual Differences, 53*, 152-156. https://doi.org/10.1016/j.paid.2011.03.028

A Field Theory of Human Intelligence

Abstract

The standard model of human intelligence is a brain-centric and brain-specific depiction of intelligence, and it enjoys nearly universal acceptance within the intelligence research community. Nonetheless, the standard model does face some serious challenges, including a lack of specificity and an inability to account for the Flynn effect (other than to assume that the Flynn effect must be a temporary aberration). What is being presented here is an alternative model of human intelligence, one that locates intelligence not within the human brain but instead within the growing amount of artificial structure contained within the human environment. Although this field theory approach to human intelligence runs counter to the widely accepted standard model, a field theory approach does offer several advantages. One, it eschews any extraordinary biological or evolutionary assumptions regarding the functioning of the human brain. Two, it provides a specific and observable description of the material structure of human intelligence. And three, it gives a straightforward and elegant explanation of the Flynn effect. For these reasons, a field theory of human intelligence merits serious consideration.

1. Introduction

The brain-centric depiction of human intelligence is so widely accepted it has become in essence the primary—and usually unstated—assumption backing nearly all intelligence research. In the standard model of intelligence, the human brain is described as producing intelligence behavior, and the brain is typically portrayed as hosting intelligence within the material confines of its assorted lobes (Barbey, 2018; Colom et al., 2010). That is to say, the human brain and its mechanisms embody the *substance* of human intelligence. This deep adherence to a brain-specific model of human intelligence is evidenced these days at the very frontiers of intelligence research, where there are now many ardent attempts being made to record intelligence in action, through a broad assortment of increasingly sophisticated neuroimaging techniques (deBettencourt et al., 2023; Kristanto et al., 2023; Zacharopoulos et al., 2023). For nearly every intelligence researcher practicing his or her craft today, there is no questioning that the human brain forms the locus of human intelligence.

Nonetheless, despite this nearly universal acceptance of a brain-centric depiction of human intelligence, the standard model does face some serious challenges. In particular, there are two major challenges, that if left unresolved, could be seen as casting significant doubt on the validity of any brain-specific model of human intelligence. The first major challenge is the lack of specificity. Although it is widely presumed that somewhere within the cerebral mesh of neurons, synapses and biochemical activity there must exist a describable set of structures and dynamics that correspond and link directly to actual intelligence behavior, to date essentially no element of this set of structures and dynamics has been detailed to any degree (Goriounova & Mansvelder, 2019). The current situation regarding specificity for brain intelligence mechanics can be likened to that of someone having inventoried the many parts composing a clock or watch, but then being unable to say anything elucidative about how those parts actually come together to represent time.

The second major challenge to a brain-centric depiction of human intelligence is the Flynn effect. The Flynn effect is the phenomenon first observed in the twentieth century—and observed nearly universally—that each generation has been scoring significantly better than previous generations on intelligence exams (Pietschnig & Voracek, 2015; Trahan et al., 2014). In other words, measurable human intelligence, as represented by the raw scores on intelligence tests, has been steadily increasing over time. This persistent and sizable increase has been so puzzling and so unexpected that many intelligence researchers have taken to insisting that the Flynn effect must be little more than a twentieth-century aberration, a temporary circumstance soon to disappear or even reverse (Dutton et al., 2016). But in fact, it can be easily demonstrated that an increase in measurable intelligence has likely been with humanity for a very long time, ever since the species' turn towards behavioral modernity, and in consequence, there is no reason to expect that the Flynn effect will end anytime soon (see *Rethinking the Flynn Effect*, within this volume). And if this is indeed the case, it poses a deep challenge to any brain-specific model of human intelligence. For if the human brain is to be described as physically producing and tangibly hosting intelligence, and if the level of that intelligence has been consistently and significantly increasing over time, what biological agency could plausibly account for such a rapid and population-wide improvement? Taken at its face value, the Flynn effect would appear to defy almost every known biological and evolutionary principle.

Given the existence of these major challenges, it is not unreasonable to consider alternative models of human intelligence. In particular, any model that could provide greater specificity regarding the material structure of human intelligence, and that could also untangle the enigma of the Flynn effect, would be a model worthy of serious consideration. A pointer to outlining such an alternative model can be found in the statement above regarding the brain and its mechanisms embodying the *substance* of human intelligence. By example and by analogy from the domain of physics, it can be noted there was a period of time, following the publication of Isaac Newton's *Principia*, when mechanistic, substance-based models of natural phenomena were the standard approach—indeed, the only approach—to explaining observed events of the physical world. Heat, for instance, was generally conceived of as a caloric substance, materially transferable from body to body. Magnetism and electricity too were similarly hypothesized as consisting of different kinds of fluid, fluid tangibly housed within the entities producing and experiencing the corresponding effect. Eventually, however, these substance-based models began running up against a series of disquieting challenges, with scientists ultimately unable to describe in detail how the proposed fluids and substances could account for the observed outcomes in a broad range of experimental trials (Einstein & Infeld, 1938).

This impasse was resolved beginning in the nineteenth century, first through the work of Michael Faraday and James Maxwell, who proposed that phenomena such as magnetism and electricity could be better described not as fluids or substances, but instead as dynamic properties of the contextual environment, as dynamic properties of a surrounding spatial-temporal field (Forbes & Mahon, 2014). This alternative approach to describing physical phenomena became known as *field theory*, and it broke the logjam that was holding up a deeper understanding of the material world. Among the many milestones that field theory has produced are Maxwell's differential equations detailing the characteristics and propagation of electromagnetic waves (Maxwell, 1865) and Einstein's gravity-solving formulas underlying general relativity (Einstein, 1916). Indeed, field theory has proven to be so effective within the domain of physics, that today almost no physical phenomena are studied as substance or material, but instead are studied almost exclusively as characteristics of a corresponding field (Wit & Smith, 1986).

Human intelligence too can be modeled as a field.

In a field theory of human intelligence, intelligence is identified with the structural properties of the human spatial-temporal environment, and in particular, with the structural properties of the *artificial aspects* of that environment. The symmetry, pattern, repetition, logic, form and so on that undergirds buildings, roadways, books, tools, etc., all this can be seen as constituting the properties of a surrounding intelligence field. Furthermore, this field is dynamic, it has undergone, and continues to undergo, an intensification. Several hundred thousand years ago, humans lived in an entirely natural setting, free of all artificial influence, which could be described as the equivalent of living in a zero-strength intelligence field. But today, as can be experienced at the heart of any modern city, humans find themselves literally surrounded by an ocean of artificiality, with the structural aspects of that artificial environment forming an extremely strong—and continuously strengthening—intelligence field.

Also, in a field theory of human intelligence, since the effective location of intelligence is placed within the surrounding environment, the human neural system, including the human brain, is released from any presumed need to physically produce and to tangibly host intelligence. This means that the human neural system can be restored to its customary biological role of being a stimulus/response mechanism, responsive in this case to the stimulus of the surrounding artificial environment, to the stimulus of the surrounding intelligence field. As a stimulus/response mechanism, the human neural system is not being called upon to engage in any extraordinary biological activity—as it is within the standard model of intelligence—because stimulus/response has been the prescribed role of neural systems since the beginning of biological time.

A field theory of human intelligence clearly runs counter to the standard brain-centric model, but a field theory of human intelligence does have several distinct advantages. For one, field theory provides a specified description of the material structure of human intelligence. Since intelligence is now being directly identified with the structural aspects of the surrounding artificial environment, describing those structural aspects is no more difficult than detailing the characteristics of the constructed world, characteristics that are entirely open to observation and are readily enumerated. This is in sharp contrast to presumed brain intelligence mechanics, which to date remain almost entirely unobserved and unspecified. Also, a field theory of human intelligence untangles the enigma of the Flynn effect. Because intelligence is now being identified with the structural aspects of the surrounding artificial environment, and because throughout human history—ever since the turn towards behavioral modernity—the amount, type and complexity of these structural aspects has been continuously increasing with time, this ongoing intensification of the surrounding intelligence field provides for an extremely straightforward and observable explanation of the Flynn effect.

2. Challenges to a Brain-Centric Depiction of Human Intelligence

Lack of Specificity

Picture if you will a modern computer on a table in the office of a Chief Financial Officer (CFO). On a daily basis, this computer performs the following set of tasks: it reads documents from the company's network containing recent billings, receipts, payroll, investment income, etc., then the computer updates the company's ledger with this new information, and finally the computer prints out a summary of current assets, liabilities, revenue, costs and profit. The CFO recognizes that this computer is displaying a type of intelligence—an accounting intelligence, if you will—an intelligence that the CFO can also display when needed. The CFO is curious about how this machine works, and one day asks a specialist from the technology department to explain the computer's underlying operations. "It seems like magic to me," the CFO says.

"Oh, it's not magic at all," the specialist replies. "There are very specific technologies underlying each step of the process. Here, let me demonstrate." The specialist then brings in some extremely sophisticated imaging equipment and arranges it around the computer. Then as the computer performs its daily set of tasks, the imaging equipment makes recordings of all the internal activity it can detect. Finally, the specialist provides an explanation of the computer's operations with the help of the pictures the imaging equipment has produced: "You see here, when the computer is performing payroll, this area gets much brighter, over near the fan, and there are some streaks of red color by the hard drive. Those are the operations of the payroll module. Now here, in contrast, when the computer is summarizing liabilities, the pattern of activity changes: it's darker near the fan but much brighter over there by the network card, and those red streaks of color have turned blue. That's the liabilities circuit running under the guidance of the balance sheet module."

The CFO looks quizzically at the specialist. "I appreciate what you've done, but that's not exactly what I meant. I still don't know how the computer works."

The specialist grins back at the CFO. "I know. I was just pulling your leg."

In way of apology for the joke, the specialist then goes on to explain and to demonstrate, in meticulous detail, the actual operations of the computer. It is not an easy or a quick task. To give a thorough explanation of how a modern computer performs something like an accounting operation requires a multi-leveled and painstakingly intricate description of many particulars: NAND gates, system-level caches, encodings, machine language, voltage sources—to name just a few of the technologies involved. Nonetheless, despite all this hierarchical complexity, the task of explication can still be sufficiently performed. There is not a single element of a computer's operation or architecture that cannot be outlined and explained in adequate detail (Hennessy & Patterson, 2012).

Now recall what was said of the CFO, that the CFO could also display accounting intelligence when needed. Here too, one could inquire about the CFO's underlying operations, how is it that the CFO can turn receipts and investment statements into an organized and meaningful financial summary? Where does this intelligence come from? If you ask intelligence researchers to explain how the CFO manages to perform these activities, here is what they would do. They would bring in some extremely sophisticated neuroimaging equipment and arrange it around the CFO. Then as the CFO performs accounting tasks, the neuroimaging equipment would make recordings of the CFO's cerebral activity. And finally, the intelligence researchers would explain the CFO's accounting intelligence with the help of the pictures and data the neuroimaging equipment has produced, including descriptions full of references to brain modules and neural pathways. But this time, unlike with the joke played by the technology specialist, everyone will be satisfied and impressed (Haier, 2021).

It might be argued that this comparison is not quite fair, that intelligence researchers do not have the luxury of tearing down a human brain and examining its parts and connections while searching for the intelligence inside—especially while the brain is in operation. But in fact researchers do already know a great deal about how the human neural system works, knowledge that comes both from post-mortem analyses and from experiments conducted on a wide range of other animal species. And what researchers know is this: in general, the human neural system, just as is the case with the neural systems of other animal species, is primarily a stimulus/response mechanism (Simmons & Young, 2010). Certain aspects of the neural system are associated with receiving environmental stimulus, such as those nerve pathways connected to the eyes. Other aspects are associated with giving response, such as those nerve pathways that provoke muscle movement. And some aspects of the neural system connect and coordinate stimulus and response, allowing the organism to act productively as a biologically cohesive whole. It is true that researchers do not yet know in complete and perfect detail every component of this stimulus/response mechanism, but as an evolutionary artifact that is shared in common across nearly the entire animal kingdom, neural systems, including brains, are not magical or mysterious. They are, by and large, stimulus/response mechanisms that have been finely tuned to support survival and procreative demands.

Intelligence, however, seems to be something quite different, a biological augmentation beyond just stimulus and response. Indeed, if researchers are talking about language production, arithmetic problem solving, logical reasoning, etc.—abilities that can be assessed via an intelligence exam—then they are no longer talking about a system shared across the entire animal kingdom. Even among hominins, measurable intelligence is an activity, historically and evolutionarily speaking, that is really quite new (Klein, 2002). So the question is, exactly what could it be inside the human brain, an organ originally and biologically designed to be part of a stimulus/response mechanism, that would allow it to assume this additional role of producing and hosting intelligence? The standard model of intelligence assumes that these additional operations must exist, but without tangible evidence and without specificity, how is it that researchers can be so sure? No matter how convinced intelligence researchers have become that somewhere inside the human brain—and somewhere inside those neuroimaging pictures—there is to be found the material source of human intelligence, could it not be just as likely that the opposite is true, that these brain-based, neuroimaging-driven assumptions are just the latest form of an old practice, are just the twenty-first century version of phrenology (Uttal, 2001)?

There is a further problem for the standard model. Recall the comparison to a modern computer, for which every aspect of its operations can be described and explained in adequate detail. That comparison also suggests that even if researchers were able to understand every intelligence operation within the human brain, that knowledge alone would still not be enough for explaining intelligence. As any computer scientist could readily attest, understanding every component and every procedure of a modern computer is not by itself sufficient to explain fully the computer's overall behavior. *On its own*, a modern computer will not display any intelligence at all—be it accounting intelligence or otherwise. To perform tasks that can be seen as the equivalent of intelligence tasks, a computer must be primed with additional structure, additional structure that comes not from the machine itself but instead comes from the surrounding environment. This additional structure might be in the form of a program uploaded into the computer's memory, or nowadays, this additional structure might come in the form of machine learning, in which the computer is trained to perform various tasks via the influence of large amounts of ambient data (Mohan et al., 2021). But either way, in order for a computer to display something that could be likened to intelligence, it must first be organized into a structural system, a structural system that is not derived from the machine itself but is instead derived from the external environment. This raises the question of whether a computer's intelligence should be attributed to the machine itself or instead to the machine's contextual surroundings. And if this question is pertinent for a modern computer, why would it not be pertinent for a human brain?

The Flynn Effect

The first iterations of the modern IQ exam began to appear early in the twentieth century, and as that century progressed a curious artifact began to emerge from the growing collection of IQ exam results: the average raw scores on these exams were getting consistently and significantly better over time. Several researchers had made note of this phenomenon, but it was James Flynn in the 1980s who demonstrated convincingly, with large amounts of data, that the phenomenon was essentially universal, and shortly thereafter it would be dubbed the Flynn effect (Flynn, 1984, 1987). The Flynn effect remains surprising and perplexing to this day.

Because raw IQ scores have been increasing since they first began to be measured, the question arises as to whether this increase would have been apparent during earlier times, had IQ exams been available prior to the twentieth century. In other words, for humans, when did this increase in measurable intelligence begin? Oddly, it seems the general consensus from the intelligence research community is that the Flynn effect began sometime near the start of the twentieth century, the coincidental timing with the invention of IQ exams apparently notwithstanding. A few researchers, including James Flynn, have suggested that the Flynn effect could trace its origin to somewhat earlier times, back to around the era of the Industrial and Scientific Revolutions (Flynn, 2007; van der Linden & Borsboom, 2019). But no researcher it seems has been willing to entertain the possibility that the Flynn effect has been operative for a much longer period of time. And coupled with these suggestions of a recent start for the Flynn effect are further suggestions that the Flynn effect soon must end—if indeed it has not ended already. One of the latest trends in intelligence research has been the diligent hunt for evidence that the Flynn effect has plateaued or even reversed (Dworak et al., 2023).

It is important to recognize that what is driving this insistence that the Flynn effect must have a recent origin and an imminent demise are the requirements of the standard model of intelligence. In order for the standard model to continue to make biological sense, the Flynn effect must be temporary. If the Flynn effect were not temporary, if it were instead to be seen as operative over an extremely long period of time, then any brain-based depiction of human intelligence would be in danger of violating biological and evolutionary principles. For instance, the type of raw intelligence gains that were apparent throughout the twentieth century, when extrapolated over a much longer period of time, would be akin to the average human body doubling in size and weight every century or two, a biological and evolutionary implausibility. If the human brain is to be depicted as producing and hosting intelligence, then in some sense intelligence must also be a biological and organic property, and thus must also adhere to biological and evolutionary principles. This means that, according to the standard model, intelligence cannot grow indefinitely—and population wide—by leaps and bounds.

The apparent need for the Flynn effect to be temporary is evident also in the many hypotheses that have been offered in way of explanation for the phenomenon. Better education, better nutrition, increased exposure to video games and puzzles, increased exposure to science, etc.—all these suggestions, explicitly or implicitly, are intended as recent and short-term boosts to brain productivity, boosts that ultimately have a limited shelf life. Nutrition and education cannot be improved forever, exposure to video games and science eventually becomes routine, and thus intelligence inevitably returns to something more stable. The apotheosis of these attempts to explain the Flynn effect as a fleeting phenomenon on top of a long-term trend towards intelligence stability can be seen in both the Dickens-Flynn model (Dickens & Flynn, 2001) and in Woodley's theory of fast and slow life (Woodley, 2012). These are parametrically complex models that attempt to reconcile a broad assortment of fluctuating environmental influences to a more stable set of genetic and biological factors that determine long-term general intelligence ability. The fluctuating environmental influences—such as education, family size, nutrition, pathogen stress, social motivators, etc.—these are all intended to account for short-term surges and pullbacks in measurable intelligence, thus allowing the Flynn effect to both wax and wane. But ultimately, these environmental influences need to give way to genetic and physical factors, factors critical for determining the biological basis of intelligence and critical for ensuring the long-term stability demanded by the standard model. Thus, the labyrinthine complexities of the Dickens-Flynn model and the Woodley theory of fast and slow life are both motivated by the presumptive need for the Flynn effect to be temporary.

But in fact, there is no conclusive evidence and no compelling reason to assume that the Flynn effect is temporary. IQ scores prior to the twentieth century do not exist, so it is not known for certain what the characteristics of measurable intelligence were before that time, and as for recent studies suggesting that the Flynn effect is ending, the data remains preliminary and is contradicted by continuing gains in many countries (Colom et al., 2023; Liu & Lynn, 2013; Nijenhuis et al., 2012). Perhaps more importantly, a straightforward analysis of human history indicates the opposite of what researchers apparently expect, indicates that far from being temporary, the Flynn effect has actually been operative within the human population for quite some time, ever since the turn towards behavioral modernity (Griswold, 2017, 2023). The easiest way to see this is to consider what the species would have been like at the moment of that turn, somewhere around a few hundred thousand years ago. Humans were still in the state of being pure animals, focused solely on survival and procreation, and were not in possession of a single characteristic that could be measured by a modern intelligence exam: no language, no arithmetic, no abstract reasoning, no construction (Klein, 2009). Administering an IQ exam to a human of that time would have been no more successful than administering an IQ exam to a wild animal today, and this means that measurable intelligence for humans a few hundred thousand years ago would have been quantifiable as absolute zero, the same as measurable intelligence for wild animals today. And since measurable intelligence has clearly progressed to a more substantive number for humans right now, that overall increase, *by definition*, is a Flynn effect. It is in fact a *massive* Flynn effect, one that has been operative over an extremely long period of time.

What is also noteworthy about this analysis of human history is that it indicates an alternative source of human intelligence, one that is consistent with an increase in intelligence over the course of that history. A few hundred thousand years ago there was no artificial construction to be found in the human environment, humans lived in an entirely natural setting. But as humans advanced towards behavioral modernity, the amount, type and complexity of the artificial construction contained within the human environment continued to accumulate over time. From simple tools, animal skin clothing, and makeshift shelters to highways, electricity, and towering skyscrapers, humans have found themselves increasingly surrounded by the ubiquitous influence of artificial construction. And this artificial construction must have something to do with human intelligence, because the *content* of an IQ exam is composed itself entirely out of artificial constructions—words, numbers, puzzles, matrices, etc. (Wechsler, 1997). When one takes an IQ exam, one is in essence demonstrating one's dexterity with artificial construction.

Thus, if intelligence can be associated to the characteristics of the artificial construction contained within the human environment—instead of to the biological characteristics of the human brain—then explaining the Flynn effect would be no more difficult than explaining the historical increase in artificial construction. The reason no one considers this association of human intelligence to the artificial constructs of the human environment is that the standard model of intelligence insists upon something else, insists that human intelligence be associated directly and solely to the human brain (Jung & Haier, 2007). But is this insistence justified? Does the standard model effectively capture the true nature of human intelligence, including the Flynn effect? If there is a reasonable and effective alternative model available, one that can associate intelligence not to the human brain but instead to the structural impact of the artificial aspects of the surrounding environment, providing for a more straightforward description of the Flynn effect, should not that model be given some serious consideration?

3. Field Theory

It is important to begin by noting that a field theory of human intelligence is not the same thing as other field theories that have been proposed in the domains of psychology and sociology (for example, those of Kurt Lewin and Pierre Bourdieu), theories that appear to be motivated by Gestalt philosophies and various socio-political doctrines (Fernández & Puente, 2009; Lewin, 1951). Instead, a field theory of human intelligence is much more akin to its physical science counterparts, such as those describing the phenomena of electricity and magnetism.

Of the different ways to characterize this type of field theory, perhaps the most straightforward is to focus upon the reactions of responsive objects to the presence of a surrounding field. For example, different kinds of metallic shavings are moved and aligned by the presence of a magnetic field, with some types of metals more responsive to that field than others. Nonetheless, the dynamic properties of magnetism are not determined by the characteristics of the metals themselves, which remain essentially constant over time, but are instead determined by the dynamic properties of the surrounding magnetic field. Within a weak magnetic field, every metal will display proportionally less reactivity, and within a strong magnetic field, every metal will display proportionally more reactivity, even though the metals themselves remain essentially unchanged. Thus, the overall intensity of the magnetic effect is determined primarily by the strength of the surrounding magnetic field (Black & Davis, 1913).

In a field theory of human intelligence, the strength of the intelligence field is determined by the amount, type and complexity of artificial construction contained within the human environment. In other words, the more artificial construction there is, the greater the intensity of the intelligence field and the greater the amount of overall intelligence that can be measured via an IQ exam. The responsive object in this scenario is the human neural system—or more particularly, the human brain—and just as some metals are more responsive to a magnetic field than are others, some human brains are more responsive to an intelligence field than are others. But the dynamic properties of human intelligence are not determined by the characteristics of these brains—characteristics that remain essentially stable over time. Instead, the dynamic properties of human intelligence are determined primarily by the changing strength of the surrounding intelligence field, by the changing amount, type and complexity of artificial construction contained within the human environment.

A few hundred thousand years ago, when humans were still pure animals and there was no artificial construction to be found anywhere within the human environment, the strength of the intelligence field would have been essentially quantifiable as zero. Human brains of that time, despite being as capable of responding to an intelligence field as are the human brains of today, would have found no artificial stimulus with which to engage, meaning that there would have been no corresponding response and thus no measurable intelligence. By around twenty-five thousand years ago, instances of artificial construction had begun to make a frequent appearance within the human surroundings—structured tools, ornamental jewelry, cave paintings, abstract sounds, etc.—and the human brains of that era, responding to the stimulus of this newfound artificial construction, would have thereby been capable of displaying intelligence behavior (Christian, 2018). Administering an IQ exam to that population would have been conceivable, even though the exam would have needed to be crude and simple by modern standards (because of limited vocabulary, primitive numeracy, etc.) Indeed, a corollary of field theory for human intelligence is that an intelligence exam, in order to be an effective and accurate measure of the intelligence for a given population, would need to reflect and to serve as a proxy for the amount, type and complexity of artificial construction to be found within that population's particular environment. A modern IQ exam such as Stanford-Binet or Wechsler would have overwhelmed an ancient population, but an appropriately simpler exam would have been able to assess that population's intelligence characteristics.

By the later era of the Mesopotamian, Egyptian and Greco-Roman empires, the artificial construction in the human environment had swelled to an even greater magnitude—permanent abodes, irrigation techniques, written words, advanced numeracy, etc. The human brains of that era, still biologically the same as human brains of previous eras, would have been responding to this increased stimulus of artificial construction—that is, to the increased strength of the intelligence field—by displaying still greater degrees of measurable intelligence. And today, in the twenty-first century, in a world now thoroughly suffused with buildings, roadways, books, televisions, computers, and so on, human brains find themselves responding ever more continuously to a growing and fast-paced array of artificially constructed stimulus, so much so that today's human brain—still biologically the same as previous human brains—can now easily handle the increased and increasing complexities of modern IQ exams, thereby demonstrating the ability to handle the increased and increasing intensity of the surrounding intelligence field.

Because the intelligence field is an observable and structured feature of the human environment, this field is in theory quantifiable. Unfortunately, there are some practical difficulties to actually making such a quantification. For one, the quantification process would be self-referencing, since quantification and measurement are themselves instances of artificial construction. Perhaps even more challenging is the fact that in the modern era, the depth, breadth and hierarchy of artificial construction contained within the human environment has reached such expansive proportions as to make the quantification task nearly impossible—on an order perhaps of cataloging and numbering all the organic and inorganic molecules contained within the oceans. Nonetheless, despite these practical difficulties, it is still possible to make accurate and meaningful statements about the dynamic properties of the human intelligence field. For instance, it should be clear from human history that the strength of the intelligence field has been continuously and significantly increasing over time, ever since the human turn towards behavioral modernity. The number and type of constructed artifacts contained within the human environment, as well as their underlying complexity, has been continuously on the rise, something that was quite observable across the course of the twentieth century, with the advent of airplanes, automobiles, electronic communication, computers and the like, a torrent of additional environmental construction coming at the same time evidence was first appearing that measurable intelligence was significantly increasing within the population.

The simplest assumption that can be made regarding the dynamic properties of the human intelligence field would be to say that growth in artificial construction is proportional to the amount of artificial construction existing at any given time. This assumption is captured in the differential equation $\mathbf{di/dt = ki}$, where $\mathbf{i}$ is the intensity of the intelligence field, $\mathbf{t}$ is time, and $\mathbf{k}$ is a positive constant of proportionality. This differential equation has a solution, $\mathbf{i = e^{kt}}$, indicating that the intelligence field strengthens exponentially with time (Trench, 2013). This assumption is perhaps not unreasonable in the modern era, when the deep interconnectedness of the entire human environment allows for innovation and new construction to spread rapidly and uniformly around the globe. Nonetheless, a longer look over the course of human history indicates that growth in the human intelligence field has generally been less regular, with localized surges and intermittent plateaus. And given that there are sociological aspects to human intelligence, it cannot be expected that its underlying formulas will display the same mathematical exactitude as do physical phenomena—the true differential equations describing the human intelligence field will likely be somewhat messy. This does not, however, invalidate the overall message of the theory, namely that the dynamic properties of human intelligence can be derived from the changing artificial aspects of the human environment.

While a field theory of human intelligence clearly runs counter to the standard brain-centric model, field theory does have several advantages that speak in its favor:

1. *A field theory of human intelligence does not require extraordinary biological and evolutionary assumptions regarding the functionality of the human brain.* In a field theory of human intelligence, the human neural system retains its traditional biological role of being a stimulus/response mechanism, and what changes is not the brain itself, but instead the environmental stimulus to which the brain responds. This means that the brain does not need to take on the supplemental and biologically extraordinary role of producing and hosting intelligence. This further implies that the human neural system has not needed to transform biologically in any significant way since the beginning of the human behavioral transformation,

an implication that is consistent with the principles of biology and evolution. Also, since what changes is the environmental stimulus, and not the brain itself, there is no biological restriction on the rate of intelligence gain, no organic hindrance to intelligence growing indefinitely—and population wide—by leaps and bounds.

2. *A field theory of human intelligence provides a specified and observable description of the material structure of human intelligence.* Because intelligence is now being identified with the structural aspects of the human artificial environment—and not with the neurons in the human brain—the material structure of intelligence is entirely open to observation. The symmetry, pattern, repetition, form and so on that underlies most types of intelligence behavior—language, arithmetic, problem solving, and the like—these characteristics exist right before researchers' very eyes, right there in the human environment. Indeed, most of these characteristics have already been cataloged and explained, using the tools of mathematics, logic and science. Precise descriptions of the structure of the artificial aspects of the material world are the same thing as precise descriptions of the material structure of human intelligence itself. This means that any attempt to uncover a *neuronal* basis for human intelligence would be to engage in nothing but a redundancy, an attempt to find something that has already been perceived. In a field theory of human intelligence, the locus of intelligence is not to be found inside the human skull. Instead, the locus of intelligence is to be found within the expanding artificial structure of the human environment.
3. *A field theory of human intelligence offers a straightforward and elegant explanation of the Flynn effect.* Measurable human intelligence, represented by the raw scores on intelligence exams, is the result of the orthogonal combination of two different factors. One of these factors is general intelligence ability, the strength of an individual's correlated scores across an assortment of intelligence tasks (Spearman, 1904). Effectively, an individual's general intelligence ability is a measure of that individual's general responsiveness to the presence of an intelligence field, an ability that differs from person to person, with the difference being driven

mostly by genetic factors (Gottfredson, 1998). General intelligence ability is the biological component of intelligence, and as such, it can be assumed that the average general intelligence ability within the human species has remained nearly constant over time, as would be expected for a biological trait. But the same cannot be said of the second factor contributing to measurable intelligence. The second factor is the total amount, type and complexity of artificial construction contained within the human environment, the target towards which general intelligence ability is applied. The amount, type and complexity of artificial construction has been significantly and consistently increasing ever since the beginning of the human turn towards behavioral modernity. And because measurable intelligence is the result of the orthogonal combination of both general intelligence ability (stable over time) and the amount, type and complexity of artificial construction (increasing over time), measurable intelligence also increases over time. This is a precise description of the Flynn effect, and it marks the increasing amount of artificial construction contained within the human environment—that is to say, the growing strength of the intelligence field—as the sole driver and the sole explanation of the Flynn effect.

In addition, a field theory of human intelligence gives rise to certain assessable predictions about the future course of human intelligence:

1. *Field theory indicates that there is no reason to expect that the Flynn effect is ending or reversing.* Since field theory suggests that the Flynn effect has been operative within the human species for many millennia—ever since the turn towards behavioral modernity—it would be too much of a coincidence to have the phenomenon come to a screeching halt right at the very moment of its discovery. More importantly, barring a human catastrophe (such as civilization collapse), it can be expected that the amount, type and complexity of artificial construction will continue to accumulate within the human environment, and future generations, responding to this increased level of artificial construction, will thereby go on to

demonstrate greater levels of measurable performance on future intelligence exams. Therefore, it can be predicted that the average level of measurable intelligence at the end of the twenty-first century will exceed by a significant amount the average level of measurable intelligence from the beginning of the twenty-first century.

2. *Field theory indicates that the content of intelligence exams will need to undergo significant alteration as time goes by.* The content of an intelligence exam is a proxy for the artificial construction contained within the human environment. The structure underlying questions regarding vocabulary, arithmetic, puzzles, matrices, etc., this structure mirrors the artificial structure that humans navigate and master in their everyday lives. Thus, an individual's performance on an IQ exam is an indirect assessment of that individual's ability to navigate and to master ambient artificial construction, and since the amount, type and complexity of that ambient artificial construction continues to increase over time, the content of IQ exams must be similarly altered in order to remain effective. In general, future questions must take on greater variety and greater complexity, because if IQ exams were not altered in this fashion, they would gradually begin to fail in their purpose, becoming less able over time to detect individual intelligence differences and to predict accurately the life circumstances impacted by intelligence ability. Therefore, it can be predicted that the content of IQ exams at the end of the twenty-first century will differ significantly from the content of IQ exams at the beginning of the twenty-first century, mostly through the incorporation of greater variety and greater complexity, in an attempt to mirror and to proxy the increasing amount, type and complexity of artificial construction to be found within the human environment.

It is not out of place to mention that both of these predictions could have been made at the beginning of the twentieth century, and would have been verified by the end of the twentieth century. And unless one is convinced that the Flynn effect must be temporary, there is no reason to expect that the current century—or any future centuries—will turn out to be any different.

4. Conclusion

The standard model of human intelligence is a brain-centric depiction of intelligence, and it enjoys nearly universal acceptance within the intelligence research community. Nonetheless, the standard model does have shortcomings, including a lack of specificity and an inability to account for the Flynn effect.

A field theory model of human intelligence directly identifies intelligence with the growing artificial structure contained within the human environment, and although this alternative approach runs counter to the widely accepted standard model, it does offer several advantages: an eschewal of any extraordinary biological or evolutionary assumptions regarding the functioning of the human brain, a specific and observable description of the material structure of human intelligence, and a straightforward and elegant explanation of the Flynn effect. For these reasons, a field theory of human intelligence merits serious consideration.

References

Barbey A. K. (2018). Network Neuroscience Theory of Human Intelligence. *Trends in cognitive sciences*, *22*(1), 8–20. https://doi.org/10.1016/j.tics.2017.10.001

Black, Newton Henry, & Davis, Harvey N. (1913). *Practical Physics.* The MacMillan Co., USA.

Christian, D. (2018). *Origin story: a big history of everything.* First edition. New York, Little, Brown and Company.

Colom, R., Karama, S., Jung, R. E., & Haier, R. J. (2010). Human intelligence and brain networks. *Dialogues in clinical neuroscience*, *12*(4), 489–501. https://doi.org/10.31887/DCNS.2010.12.4/rcolom

Colom, R., García, L. F., Shih, P. C., & Abad, F. J. (2023). Generational intelligence tests score changes in Spain: Are we asking the right question? *Intelligence, 99*, 101772. https://doi.org/10.1016/j.intell.2023.101772

deBettencourt, M. T., Bainbridge, W. A., & Rosenberg, M. D. (2023). Functional neuroimaging. In H. Cooper, M. N. Coutanche, L. M. McMullen, A. T. Panter, D.

Rindskopf, & K. J. Sher (Eds.), APA handbook of research methods in psychology: Foundations, planning, measures, and psychometrics (pp. 631–653). American Psychological Association. https://doi.org/10.1037/0000318-029

Dickens, W. T., & Flynn, J. R. (2001). Heritability estimates versus large environmental effects: the IQ paradox resolved. *Psychological review*, *108*(2), 346–369. https://doi.org/10.1037/0033-295x.108.2.346

Dutton, E., van der Linden, D., & Lynn, R. (2016). The negative Flynn Effect: A systematic literature review. *Intelligence, 59,* 163–169. https://doi.org/10.1016/j.intell.2016.10.002

Dworak, E. M., Revelle, W., & Condon, D. M. (2023). Looking for Flynn effects in a recent online US adult sample: Examining shifts within the SAPA Project. *Intelligence*, *98*. https://doi.org/10.1016/j.intell.2023.101734

Einstein, A. (1916) The Foundation of the General Theory of Relativity. Annalen der Physik, 49, 769-822. http://dx.doi.org/10.1002/andp.19163540702

Einstein, A. & Infeld, L. (1938). The evolution of physics: the growth of ideas from early concepts to relativity and quanta. New York, Simon and Schuster.

Fernández, J.M.F. & Puente, Aníbal. (2009). The notion of field in Kurt Lewin and Pierre Bourdieu: a comparative analysis. Revista Espanola de Investigaciones Sociologicas. 33-53.

Flynn, J. R. (1984). The mean IQ of Americans: Massive gains 1932 to 1978. *Psychological Bulletin, 95*(1), 29–51. https://doi.org/10.1037/0033-2909.95.1.29

Flynn, J. R. (1987). Massive IQ gains in 14 nations: What IQ tests really measure. *Psychological Bulletin, 101*(2), 171–191. https://doi.org/10.1037/0033-2909.101.2.171

Flynn, J. R. (2007). *What is intelligence?: Beyond the Flynn effect*. Cambridge University Press.

Forbes, N. & Mahon, B. (2014). *Faraday, Maxwell, and the Electromagnetic Field: How Two Men Revolutionized Physics*. Prometheus Books.

Goriounova, N. A., & Mansvelder, H. D. (2019). Genes, Cells and Brain Areas of Intelligence. *Frontiers in human neuroscience*, *13*, 44. https://doi.org/10.3389/fnhum.2019.00044

Gottfredson, L. S. (1998). The general intelligence factor. Scientific American Presents, 9, 24-29.

Griswold, A. (2017). *Concerto for Intelligence*. iUniverse. (accessible online: https://www.grizzalan.com/concertoforintelligence)

Griswold, A. (2023). *Autistic Rhapsody*. iUniverse. (accessible online: https://www.grizzalan.com/autisticrhapsody)

Haier, R. J. (2021). Are we thinking big enough about the road ahead? Overview of the special issue on the future of intelligence research. *Intelligence*, *89*(C). https://doi.org/10.1016/j.intell.2021.101603

Hennessy, J. L., & Patterson, D. A. (2012). *Computer Architecture: A Quantitative Approach*. Amsterdam: Morgan Kaufmann. ISBN: 978-0-12-383872-8

Jung, R. E., & Haier, R. J. (2007). The Parieto-Frontal Integration Theory (P-FIT) of intelligence: converging neuroimaging evidence. *The Behavioral and brain sciences*, *30*(2), 135–187. https://doi.org/10.1017/S0140525X07001185

Klein, R. (2002). *The Dawn of Human Culture*. New York: Wiley.

Klein, R. G. (2009). *The human career: Human biological and cultural origins*. University of Chicago Press.

Kristanto, D., Hildebrandt, A., Sommer, W., & Zhou, C. (2023). Cognitive abilities are associated with specific conjunctions of structural and functional neural subnetworks. *NeuroImage*, *279*, 120304. https://doi.org/10.1016/j.neuroimage.2023.120304

Lewin, K. (1951). Field theory in social science: selected theoretical papers (Edited by Dorwin Cartwright.). Harpers.

Liu, J., & Lynn, R. (2013). An Increase of Intelligence in China 1986-2012. *Intelligence*, *41*(5), 10.1016/j.intell.2013.06.017. https://doi.org/10.1016/j.intell.2013.06.017

Maxwell, J. C. (1865). A Dynamical Theory of the Electromagnetic Field. *Philosophical Transactions of the Royal Society of London*, *155*, 459–512. http://www.jstor.org/stable/108892

Mohan, N., Singla, R., Kaushal, P., & Kadry, S. (Eds.). (2021). Artificial Intelligence, Machine Learning, and Data Science Technologies: Future Impact and Well-Being for Society 5.0 (1st ed.). CRC Press. https://doi.org/10.1201/9781003153405

Nijenhuis, J.T., Cho, S.H., Murphy, R., & Lee, K.H. (2012). The Flynn effect in Korea: Large gains. Personality and Individual Differences, 53, 147-151. https://doi.org/10.1016/j.paid.2011.03.022

Pietschnig, J., & Voracek, M. (2015). One Century of Global IQ Gains: A Formal Meta-Analysis of the Flynn Effect (1909–2013). *Perspectives on Psychological Science*, 10(3), 282-306. https://doi.org/10.1177/1745691615577701

Simmons, P., & Young, D. (2010). Nerve cells and animal behaviour (3rd ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511782138

Spearman, C. (1904). 'General intelligence,' objectively determined and measured. The American Journal of Psychology, 15(2), 201–293. https://doi.org/10.2307/1412107

Trahan, L. H., Stuebing, K. K., Fletcher, J. M., & Hiscock, M. (2014). The Flynn effect: a meta-analysis. *Psychological bulletin*, *140*(5), 1332–1360. https://doi.org/10.1037/a0037173

Trench, William F., "Elementary Differential Equations" (2013). *Faculty Authored and Edited Books & CDs*. 8. https://digitalcommons.trinity.edu/mono/8

Uttal, W. R. (2001). *The new phrenology: The limits of localizing cognitive processes in the brain*. The MIT Press.

van der Linden, M., & Borsboom, D. (2019). Affluence boosted intelligence? How the interaction between cognition and environment may have produced an eighteenth-century Flynn effect during the Industrial Revolution. *The Behavioral and brain sciences*, *42*, e211. https://doi.org/10.1017/S0140525X19000190

Wechsler, D. (1997). *WAIS-III administration and scoring manual*. The Psychological Corporation, San Antonio, TX.

Wit, B.D., & Smith, J.F. (1986). *Field theory in particle physics*.

Woodley, M. A. (2012). A life history model of the Lynn-Flynn effect. *Personality and Individual Differences, 53*, 152-156. https://doi.org/10.1016/j.paid.2011.03.028

Zacharopoulos, G., Sella, F., Emir, U., & Cohen Kadosh, R. (2023). Dissecting the chain of information processing and its interplay with neurochemicals and fluid intelligence across development. *eLife*, *12*, e84086. https://doi.org/10.7554/eLife.84086

Scientific Revolutions, Abductive Reasoning, and Autism

Abstract

Thomas Kuhn's depiction of scientific revolution has much in common with Charles Sanders Peirce's portrayal of abductive reasoning, with each description outlining a template for the overthrow and reconstruction of contextual frameworks. Such upheavals are often ignited by a single individual and are frequently idiosyncratic and iconoclastic in nature. Accordingly, this essay explores the role autism plays in both scientific revolution and abductive reasoning, with an emphasis on the atypical perceptual characteristics that autistic individuals bring to the human population, characteristics that are focused intensely on the underlying structural features to be found in the surrounding environment. Finally, the observation is made that the community-heavy practices of today's scientific world are systematically suppressing atypical perspectives, accounting for the current paucity of scientific revolution.

1. Introduction

Thomas Kuhn's 1962 book *The Structure of Scientific Revolutions* (Kuhn, 1962) is an interesting example of a self-referencing idea. In the work, Kuhn outlines a description of how scientific frameworks tend to transform over time, through a roughly cyclical pattern of paradigm, anomaly, crisis, and then paradigm shift—in essence, through a series of stasis-breaking challenges and radical reformulations. This description runs counter to the then-prevailing view that science progresses in a more incremental and accretive fashion, using the tools of verifiability and falsifiability to nudge the scientific community towards consensus in the face of new and/or competing theories. Kuhn's work has received its share of criticism over the years (Masterman, 1970; Sanbonmatsu & Sanbonmatsu, 2017), but there is no questioning that the book has had a profound influence on the history and philosophy of science, its themes now deeply ingrained into the mindsets of both practicing scientists and the general public as they survey how human knowledge has unfolded during the past and continues to develop through the present day (Kaiser, 2012). Which is to say, *The Structure of Scientific Revolutions* has itself produced a meaningful and persistent paradigm shift.

Kuhn's template for scientific revolution is similar in many respects to the concept known as abductive reasoning. Abductive reasoning was brought into prominence by the nineteenth-century American philosopher Charles Sanders Peirce, who explored the topic frequently throughout his copious writings on logic, scientific classification, semiotics and pragmatism (Peirce, 1992, 1998). Peirce himself sometimes struggled to nail down the exact nature of abductive reasoning, admitting at one point that he had perhaps confused some of its characteristics with those of inductive reasoning during the earlier stages of his career. But Peirce was also the one who crafted, in typical Peircean fashion, the incisive and pithy formula by which abductive reasoning is still commonly articulated today:

> The surprising fact, C, is observed.
> But if A were true, C would be a matter of course.
> Hence, there is reason to suspect that A is true.

Abductive reasoning can be applied against a broad range of circumstances, from personal events to scientific revolutions, but it was for the latter type of application that Peirce stressed the immense importance of abductive reasoning, noting it was the only form of logic by which humans discover and develop anything new.

A distinctive and somewhat enigmatic feature of both scientific revolutions and abductive reasoning is the aha moment, that sudden perception of an effective solution to what had been previously a vexing problem. Kuhn and Peirce say only a little about this epiphanous event, with Kuhn likening it to a change in gestalt—such as the drawing that transitions suddenly from duck to rabbit—and with Peirce describing the insight as coming to us "like a flash" and as "putting together what we had never before dreamed of putting together." Implicit in these brief portrayals is a corollary also evident from the history of scientific revolutions, namely that these aha moments are exclusively the product of an individual, and never the product of a group.

This essay will explore the role autism plays in both scientific revolution and abductive reasoning, including the spawning of these aha moments. Autism is usually regarded as a medical condition (Hodges et al., 2020), but here an alternative approach will be given extensive consideration, with an emphasis on how the biological, behavioral and sensory characteristics of autism naturally give rise to an atypical form of human perception. It will be demonstrated that it is this atypical form of perception that catalyzes the abductive reasoning underlying knowledge innovation, and as partial evidence for these assertions, it will be discussed how surprisingly often autistic characteristics have made a prominent appearance in the history of scientific revolutions.

Finally, the paradigm under which the scientific community currently operates will be examined with a critical eye. Kuhn's 1962 work can be seen as being highly influenced by the circumstances of the scientific community of that time, and because of this influence, Kuhn misapprehended the state of science as it existed before the beginning of the twentieth century, and also failed to anticipate the predicament into which science would fall by the end of the twentieth century. As scientific work has become more popular, more collaborative and more financially rewarding—and less frequently the domain of unusual and isolated individuals—the scientific community has found itself becoming increasingly stuck inside the regimen Kuhn labels as *normal science*. In the present day, normal science is producing a particularly deleterious effect, it is systematically suppressing the revolutionary and beneficial impact of atypical autistic perception.

2. Scientific Revolutions

Kuhn is best known for his introduction of the concept of *paradigm shift*, but paradigm shift is only one aspect—and often too narrowly understood—of Kuhn's more encompassing description of a cycle of stasis and upheaval underlying historical scientific change. The word *paradigm* for Kuhn is a convenient label for the circumstances of a mostly stable and generally agreed-upon scientific practice, as embodied by the scientific community in the form of textbooks, journals, conferences, constructive collaboration, and so on. During this period of what Kuhn calls *normal science*, the scientific community's efforts are directed almost entirely towards the confirmation and shoring up of the sanctioned framework, with little to no endeavor directed towards change and overthrow. What eventually disturbs a paradigm is the accumulation and/or significance of anomalies, problems that stubbornly defy all effort to be resolved within the context of prevailing theories. These anomalies foment a state of crisis within the community, with the crisis prone to being answered by the introduction of an entirely new framework, one often incommensurable with the old way of seeing things. If this new framework proves to be effective at both resolving the anomalies and clearing the landscape for future progress, the scientific community will gradually abandon the old framework and adopt the new, establishing the next paradigm for ongoing scientific practice. Thus, *paradigm shift* can be seen as having two different but related meanings. One, paradigm shift can refer to the adoption of the new paradigm over the old one, a process that is often slow moving and happens under the reluctant sway of the scientific community. And two, paradigm shift can refer to the insightful perception of a new and effective framework, an event that can occur suddenly and remains the province of just one individual.

Perhaps the quintessential example of these concepts is Einstein's introduction of special relativity (Einstein, 1905). The prevailing paradigm leading up to that occasion was still mostly that of Newtonian mechanics, buttressed by additional features to accommodate Maxwell's already anomalous field theory of electromagnetic waves. One of these additional features was the luminiferous ether, the hypothesized medium through which light, electricity and magnetism could propagate, but efforts to detect motion through this ether, including the famous Michelson-Morley experiment (Michelson & Morley, 1887), had instead produced an incongruous result, namely that the speed of light remained the same in every direction measured, no matter the velocity of the source. Several attempts were made—for instance, by Hendrik Lorentz and Henri Poincaré (Lorentz, 1904; Poincaré, 1900)—to reconcile this outcome to the prevailing framework, but because these efforts still clung to the existing paradigm, they failed to provide the necessary clarification. That task fell to the young Einstein, still a patent office clerk, who after several years of grappling with the problem, found sudden inspiration in the early summer of 1905 and completed his famous paper on the electrodynamics of moving bodies in a mere matter of weeks. That paper did not cling to the existing paradigm but instead boldly defied it, proclaiming the ether to be superfluous and postulating an entirely new conception of space, time, matter and energy.

As is often the case, Einstein's revolutionary ideas, despite resolving the anomalies concisely and clearing the ground for future progress, did not meet with immediate acceptance from the scientific community; nearly two decades would pass before relativity became firmly established as the basis for the next paradigm (Goldberg, 1970). Many of Kuhn's other examples of scientific revolution follow a similar course: Copernicus's heliocentric model of cosmology, Newton's laws of motion and gravity, Dalton's atomic theory of chemistry, Darwin's description of natural selection—all these innovations were the inspiration of an individual, and all were met with initial resistance by the larger group (Barber, 1961). There exists an inherent tension in each case of scientific revolution, the tension between the scientific community's intrinsic adherence to the familiar way of seeing things versus an individual's disruptive introduction of an atypical counter perception (Kuhn, 1978).

Kuhn applies his ideas almost exclusively to the domain of the natural sciences, but in a broader sense, *science* is simply a term for the pursuit of greater understanding, and thus Kuhn's scheme can just as effectively be applied to knowledge acquisition in general. The first control of fire, the first use of abstract language, the first mathematical concept—these moments are lost to prehistory, but there is no reason to expect they were not the inspiration of uncommon individuals, and were met with initial resistance by the guardians of the then-current conventional wisdom. This pattern of human knowledge advancement, accretive in its totality but reconstructive at its core, is in many respects the primary distinguishing feature of the modern form of the human species (Griswold, 2023). Ever since the turn towards behavioral modernity, humans have been increasingly distancing themselves from their purely animal past by reassessing and reconstructing their surrounding environment, and this activity has not been accomplished in a sociable, gradual and piecemeal fashion, but instead has been accomplished via dissension and upheaval, via the constant tearing down of the old paradigm and the rebuilding of the new. The great scientific discoveries of the last several centuries are simply recent examples of what has actually been a long-running human process, a process that, not coincidentally, is both unprecedented within the biological kingdom and is also powered by the fuel of atypical perception.

3. Abductive Reasoning

Over the past decade or so, abductive reasoning has experienced a surge in scholarly interest, so much so that the topic has become something of an academic cottage industry: classifications of abductive patterns (Park, 2015; Schurz, 2008), competing analyses of underlying logical schemas (Lycke, 2012; Urbański, 2022), endless battles over whether *inference to the best explanation* is the same thing as abduction (Campos, 2011; Mcauliffe, 2015), etc. To sidestep some of this noise, the focus here will remain on Peirce's original three-line formula, with an italicized emphasis on those phrases that appear to be the most under-appreciated within the academic community:

> The *surprising fact*, C, is observed.
> But if A were true, C would be *a matter of course*.
> Hence, there is reason to suspect that A is true.

The observed fact needs to be *surprising* because abduction begins when something appears to be amiss or inadequate with the contextual framework. New facts, or facts that can be easily assimilated to what is already well understood, do not stimulate the kind of perturbation that comes with abduction—a surprising fact is provocative, a soon-to-be-explained fact is not. Furthermore, the real sting in Peirce's formula is in the transformation C undergoes from being a *surprising fact* to being *a matter of course*. That is no small leap. If C is originally a surprising fact—indicating trouble with the contextual framework—then almost by necessity the fact transitions to being a matter of course only via a radical change to the contextual framework, a change sometimes so sweeping as to render the new framework incommensurable with the old. Contextual frameworks can run the gamut from personal worldviews to the shared paradigms of the natural sciences, but in each instance the framework's purpose is to provide clarification and orientation, and when it fails to do so, it needs to be discarded and rebuilt anew. Thus, the A of Peirce's formula is often much more than just an explanatory hypothesis, the A of Peirce's formula is what people now commonly call a paradigm shift.

Consider some examples. The first example is the already mentioned introduction of special relativity. Just about any instance of scientific revolution could serve as illustration for abductive reasoning—special relativity happens to be particularly thematic. There were two major anomalies, or surprising facts, that provoked Einstein's scrutiny. One, there was the unexpectedness of the Michelson-Morley result, doggedly indicating no detectable motion through the luminiferous ether. And two, no one, including Einstein himself, seemed to be able to adjust Maxwell's electromagnetic equations to make them conform to the Galilean relativity principle (Earman et al., 1982). Einstein's solution to these challenges, simple in conception but monumental in consequence, did indeed transform both of these anomalies into a matter of course. The first anomaly was resolved by raising the constancy of the speed of light in every inertial frame to the level of postulate, rendering the Michelson-Morley outcome straightforward and trivial. This also cleared up the second anomaly, by allowing Einstein to demonstrate that his inability to make Maxwell's equations conform to the relativity principle was ironically correct, because in fact no adjustment was needed, the equations already conformed as they were.

Here, the A of Peirce's formula was nothing short of the overthrow of the contextual framework of physics, a complete reconceptualization of space, time, matter and energy. What was gained by this disruption was clarification, a clearing of what had been previously a problematic landscape, a reorientation allowing scientists to proceed. Compare this outcome to the approach taken by Hendrik Lorentz. Lorentz, prior to Einstein, had already developed much of the mathematics describing relativity, but had done so through a strained effort to accommodate the perceived anomalies to the prevailing Newtonian/Maxwellian framework, and the strain shows. Time dilation for Lorentz was in essence a mathematical trick, a kludge to force the equations to conform to the relativity principle. And length contraction was a mysterious property imposed upon moving bodies by the luminiferous ether, calibrated precisely to the Michelson-Morley result. These interpretations, *even if they were true*, would not provide clarification, but would instead simply shift the venue of the anomalies. A mathematical trick that seems to work with time is itself anomalous; compression of moving bodies by a massless ether is itself a surprising fact. Abduction—especially ampliative abduction, the kind that produces new understanding—is less about the search for plausible hypotheses than it is about the quest for clarification. Both Einstein and Lorentz had offered plausible hypotheses, but Einstein's paradigm shift produced clarification, Lorentz's strained fit to the old paradigm did not.

To take a more everyday example, consider the following scenario. A man wakes up on Friday morning, showers, dresses for work, has breakfast, then walks to the bus stop and waits for the 8:30 bus. But the bus does not arrive. The man is perplexed—this has never happened before, and he begins to get a vague sense that something is wrong. Maybe the bus has broken down, he thinks, and he will need to find an alternative means to get to work, but nothing about that explanation, *even if it were true*, seems satisfying to him. Then suddenly it hits him—today is not Friday, today is Saturday! Of course the bus has not arrived! The man also now recognizes the source of his vague sense that something was wrong—no one else is at the bus stop and there is less traffic on the road. Everything has become clear to him now and he walks home to begin his Saturday chores.

The surprising fact in this scenario is that the bus does not arrive, and as is often the case, many explanations can be offered to account for this surprising fact. But explanations are not the goal here, clarification is the goal. The hypothesis that the bus has broken down is perfectly reasonable, probably even the most likely, but it does not do anything to clarify this man's situation, in fact it leaves it more messy than before. Will the bus service send a backup? Should he call for a taxi? Do taxes need to be raised in this city to promote better vehicle maintenance, etc.? Of course, reality is often like that, the facts do turn out to be messy sometimes, and humans must learn to deal with those situations too. But contextual frameworks do not have the luxury of being messy—their sole purpose is to provide clarification and orientation, and when one can successfully make use of them, they are the most advantageous of tools. Thus, when the man suddenly realizes that today is actually Saturday and not Friday—that is, when he swaps out one contextual framework for another—his world transitions immediately from being problematic to being crystal clear. He knows how to proceed because he has been afforded the gift of a useful abduction.

As a final example, consider a present-day anomaly that appears to be in need of a scientific revolution—the Flynn effect. It was early in the twentieth century when IQ exams were first created and administered, and as that century progressed, it was observed that the raw scores on these exams were significantly increasing over time (Pietschnig & Voracek, 2015; Trahan et al., 2014). James Flynn in the 1980s documented, with large amounts of data, that this phenomenon was essentially universal, and the phenomenon soon thereafter would be dubbed the Flynn effect (Flynn, 1984, 1987). The prevailing paradigm regarding human intelligence is that it is a product of the human brain—that is, somewhere within the cerebral mesh of neurons, synapses and biochemical activity, the mechanisms of intelligence make their biological home (Jung & Haier, 2007). But given this contextual framework for intelligence, the Flynn effect emerges as a surprising fact. Evolutionary principles generally preclude such a rapid and population-wide improvement in a biological capacity—the expected outcome is that the average level of human intelligence would remain stable over time.

There have been countless explanations offered for the Flynn effect. For instance, it has been suggested that such factors as better nutrition (Lynn, 1989), greater access to formal education (Baker et al., 2015), increased exposure to video games and puzzles (Clark et al., 2016), etc.—or various combinations of the above (Jensen, 1998)—have contributed to an overall increase in the efficiency of human brains. In addition, several comprehensive models have been proposed hypothesizing a combined genetic and ecological causality for changing levels of human intelligence, intricate formulations such as the Dickens-Flynn model (Dickens & Flynn, 2001) and Woodley's theory of fast and slow life (Woodley, 2012). These explanations all have two characteristics in common. One, each explanation adheres to the prevailing paradigm of a brain-centric mechanism for human intelligence, casting its solution as impactful upon the effectiveness of the human brain. And two, each explanation, *even if it were true*, would provide little in the way of clarification. For instance, it would remain entirely unspecified how better nutrition, greater access to formal education, or increased exposure to video games and puzzles would induce the type of intense biological and neurological impact required to boost intelligence scores universally. And formulations such as the Dickens-Flynn model and Woodley's theory of fast and slow life are themselves more labyrinthine and more undetermined than the anomaly they are meant to explain (contrast these formulations, for instance, to Einstein's two-postulate model of relativity).

The odd thing is, the current situation regarding the Flynn effect would seem to provide the ideal backdrop for a Kuhnian crisis, and yet the intelligence research community shows no indication of being flummoxed at all. Its relentless adherence to the existing paradigm and its continuing pursuit of non-clarifying hypotheses suggest this community will remain in its current state for quite some time, and this raises a further question of whether something about Kuhn's description of scientific revolution has itself become anomalous in the twenty-first century (more on this topic shortly). Nonetheless, whether the scientific community is aware of this crisis or not, abductive reasoning would indicate that the most promising path forward with regard to the Flynn effect would be to transform the contextual framework, to shift the prevailing paradigm, to reconceptualize human intelligence (see *A Field Theory of Human Intelligence*, in this volume).

The first two examples—special relativity and the non-arriving bus—each contain an aha moment: in his later years, Einstein narrated a description of how a casual conversation on a beautiful Bern day gave him a sudden insight into the nature of his relativity problem, opening the pathway to his famous paper (Stachel, 2002), and of course in the example of the non-arriving bus, the aha moment comes with the sudden realization that the day is Saturday. These aha moments, even when connected to widely shared paradigms, are almost always personal and solitary in nature—the history of science is chock-full of such epiphanies, but they are the epiphanies of individuals, never the epiphany of an entire group. And indeed, as can be seen in the case of the Flynn effect, the scientific community is actually inclined towards the *opposite* of the aha moment, is inclined towards a mutual and fixed regard for the prevailing paradigm. Thus, there appear to be two types of perception at work within the human population, each antipodally aligned with respect to abductive reasoning and scientific revolutions. One type of perception is prone to being communal and conservative, inherently friendly towards conventional wisdom and the favored paradigm, and could be fairly labeled as *typical* perception. The other type of perception is prone to being idiosyncratic and iconoclastic, naturally distrustful of the popular perspective, and could be fairly labeled as *atypical* perception. Both types of perception play important and reciprocal roles in the maintenance and reconstruction of human knowledge, and there is value to be gained in understanding more fully the distinction between them. To that end, the discussion now turns to the concept known as *autism*.

4. Autism

Autism was first recognized and described in the mid-twentieth century, particularly with the publication in the 1940s of case studies by psychiatrist Leo Kanner (Kanner, 1943) and pediatrician Hans Asperger (Asperger, 1944), studies that highlighted the defining behavioral characteristics of the autistic condition—namely, social difficulties, language peculiarities, and an intense focus on circumscribed interests. In the decades that immediately followed these publications, autism was regarded almost invariably as a dire medical condition, exceedingly rare and leading to outcomes inevitably poor (Evans, 2013). However, the current view regarding autism has changed enormously from those earlier times, with two primary developments triggering the transformation (O'Reilly, 2020). First, the prevalence of autism has turned out to be much greater than was originally assumed, increasing by orders of magnitude from initial estimates of around 1 in 2000 (0.05%) to the current estimates of around 1 in 50 (2.0%) (Ballan & Hyk, 2019). And secondly, along with this recognition of significantly greater numbers of autistic individuals has come the parallel realization that only a small percentage of their outcomes turn out to be anything resembling the word *dire*. In actuality, autistic outcomes constitute an extremely broad range, with indeed some individuals experiencing serious developmental difficulties and requiring lifetime assistance and care, but with many others leading lives of almost indistinguishable normalcy, and with some attaining lives of exceptional achievement (Reis et al., 2022). The word *spectrum* is now frequently employed to depict the wide variability in both autistic presentation and autistic outcomes, and although the word is apt to be misused at times, *spectrum* does capture an aspect of how autism is generally regarded today.

Nonetheless, the lingering stigma from the earlier views regarding autism does continue to have some unfortunate consequence, the most troubling being the long-lasting impact upon the autism research community. That community still studies autism primarily as a medical condition, focusing nearly all of its efforts and resources on discovering causes and cures. For many decades now, autism research has been directed towards finding the genetic defect that underlies autism (Reiss et al., 1986; Rylaarsdam & Guemez-Gamboa, 2019), towards describing the neurological aberration that explains autism (Haas et al., 1996; Pan et al., 2021), and towards uncovering the environmental insult that produces autism (Cattane et al., 2020; Kern & Jones, 2006), frequently with the stated goal of eradicating, or at least ameliorating, the features of the condition. But these many decades of research have produced literally nothing in the way of results: there is no known genetic defect underlying autism, there is no known neurological aberration explaining autism, and there is no known environmental insult producing autism (Hodges et al., 2020). When it comes to advancing a medical understanding of autism, the scientific community stands no differently today than it did dozens of years ago, and indeed the verdict remains entirely open as to whether autism should be regarded as a medical condition at all.

This essay will examine, in brief outline form, an alternative description of autism, one that takes into full account the biological, behavioral and sensory characteristics that define autism, but that also looks beyond the narrow restriction of perceiving autism as just a medical condition. This alternative description of autism will begin in perhaps an unexpected way, with a thorough account of *non*-autism—that is to say, a thorough account of what it means to be biologically typical—with an emphasis on the specific perceptual characteristics that delineate non-autism. This description of non-autism will include a focus on the biological and evolutionary importance of a concept known as *conspecific perception*, the innate tendency to perceive first and foremost the other members of one's own species (Buxton et al., 2020). With this description of non-autism in place, autism will then be contrastingly described as a significant lack of conspecific perception, a lack that both produces the observable characteristics of the condition and also leads directly to a compensatory and divergent form of perception. Finally, these two different types of perception—non-autistic *typical* perception and autistic *atypical* perception—will be described as producing in tandem a revolutionary impact upon the entire human species, including being the source of the typical/atypical perceptual divide that characterizes the essential tension at the core of abductive reasoning and scientific revolutions.

In outline form, this alternative description of autism can be presented as follows (a more thorough account can be found in the author's other writings (Griswold, 2007, 2023; *Prototypical Autism Is Transformatively Atypical*, in this volume)):

1. *Non-autistic, or biologically typical, humans possess fully those perceptual and behavioral characteristics that have carried forward from humanity's not-so-distant animal past.* Until recently in their evolutionary history, humans were still pure animals, with their perceptions and behaviors centered exclusively around survival-and-procreative demand—food, water, danger, sex, etc. (Klein, 2009). Not until the turn towards behavioral modernity, starting around a few hundred thousand years ago, did humans begin to add the other perceptions and behaviors that now distinguish the species from the remainder of the animal kingdom (Klein, 2002).

Nonetheless, the influence of those animal-origined perceptions and behaviors still remains strong today. Most members of the current population, despite living in artificially constructed environments and despite having most of their biological needs easily met, continue to give a great deal of attention and effort to those familiar targets—food, water, danger, sex, etc.—and much of current human activity is still guided by a shared interest in these familiar themes.

2. *Among the carryovers from humanity's animal past, conspecific perception plays a central role in determining the social and behavioral characteristics of the population. Conspecific perception* is the innate tendency to perceive first and foremost the other members of one's own species, a tendency apparent in essentially *all* animal species: lions perceive first and foremost other lions, honeybees perceive first and foremost other honeybees, etc. Conspecific perception foregrounds intra-species sensory experience against a less distinct sensory background, and this tendency is evolutionarily crucial for allowing mates to discover mates, parents to focus on their offspring, offspring to follow their parents, members of a pack to track one another, and so on. Conspecific perception is quite strong within the human species, as it would be for any species considered to be highly social, and it has the impact of drawing the human population together, because most humans possess a natural and shared interest in observing other humans and in mimicking what other humans do.
3. *Conspecific perception also plays a critical role in the sensory and developmental progress of human individuals.* When a human child enters this world he or she must first achieve a sensory grounding, because otherwise, the sensory impressions a child experiences would remain chaotic and unorganized. As is evident from the rapt, natural and delighted attention most children give to other humans and to human activities, conspecific perception is one of the primary means by which human children attain their sensory grounding. From the manifold of impressions that arises in the sensory field, what emerges most predominantly for most children are human sights, human voices, human smells, human activities, and so on.

A human child then uses this human-forward sensory grounding to pursue further developmental progress, including first steps into the leveraging world of human language. Thus, most children today owe their perceptual and developmental start primarily to the species' shared and natural interest in all things human.

4. *Biological perception in general, and conspecific perception in particular, has the persistent impact of locking a species into a perceptual and behavioral stasis.* Animal perceptions and behaviors are remarkably stable, both across species and across time. Nearly all wild animal species today live lives that are essentially the same as they were hundreds of thousands of years ago, lives similar to those of the *other* animal species, lives intensely focused on survival-and-procreative demand—food, water, danger, sex, etc. Even evolutionary change does not alter this pattern—the resultant species will live the same biologically and conspecifically focused life as did the predecessor species. With the turn towards behavioral modernity, the human species has clearly broken out of this rigid pattern, with its members living lives today that are much different than they were in prior times. But it is important to recognize that until quite recently in their evolutionary history, humans were just as locked into the confining consequences of biological and conspecific perception as were all the other animals, raising the question of exactly how it came to be that this lock was broken.
5. *Autism can be characterized as a significant diminution of conspecific perception.* In marked contrast to biologically typical individuals, autistic individuals can be seen as displaying a diminished awareness and attention for other human beings. Young autistic children do not engage as readily or willingly with other people as non-autistic children generally do, and autistic children appear to be much less interested in observing or participating in human-related activities (Hedger & Chakrabarti, 2021). These behaviors are frequently characterized as *social* difficulties, but in a sense that phrase mischaracterizes the trait. The so-called social difficulties of autistic children are not the result of a particular social defect so much as they are the result of a substantial perceptual distancing from the species itself. That is to say, the social difficulties of

autistic children are the most clearcut evidence of their significant lack of conspecific perception.

6. *The diminution of conspecific perception in autistic children thwarts their attainment of a sensory grounding by the typical means.* The degree to which conspecific perception is diminished in autistic individuals can vary, and this may explain in part the spectrum-like nature of autistic presentation and outcomes. But the diminishment is always significant in the following sense: autistic children, unlike biologically typical children, cannot organize their sensory experience around a natural predominance of human-centric features. Almost every autistic child experiences sensory issues (Hazen et al., 2014), issues that range all the way from hypersensitivity to hyposensitivity to synesthesia, and the motleyness of these sensory symptoms suggests they are not the product of a particular physical cause so much as they are the consequence of a generalized difficulty in organizing sensory experience. From the manifold of impressions that arises in the autistic child's sensory field, human sights, human voices, human smells, etc., they do not emerge predominately from the sensory background (as they do for non-autistic children). This leaves the autistic child without a sensory grounding, navigating what must seem to be the near equivalent of a sensory chaos, and if these circumstances are not resolved, the child can be expected to encounter nearly insurmountable developmental challenges.
7. *To attain their sensory grounding, most autistic children adopt an alternative form of perception, one that can be characterized as a heightened attention and awareness for the inherent structural features that stand out from the surrounding environment.* Although usually delayed compared to their non-autistic peers, most autistic children do overcome their developmental challenges, and this developmental progress indicates that most autistic children do attain a sensory grounding, a result evidenced also by the fact that their sensory issues tend to ease over time (Kern et al., 2006). But since an autistic child's overcoming of a potential sensory chaos is not being achieved through the predominant influence of conspecific perception, it must be getting achieved by some other

means. *Chaos* as a term denotes a lack of structure, and chaos is generally dissolved by the emergence of structural features—symmetry, repetition, pattern, number, form. Autistic children provide abundant evidence that they overcome their sensory chaos by focusing not on other people, but instead by focusing on the structural elements to be found in their surrounding environment. Ceiling fans, spinning wheels, light switches, the shapes of letters, sports statistics, dinosaur taxonomy, etc. The structure-suffused interests and activities of autistic individuals form a lengthy list. This is a core and defining characteristic of autism, and is often referenced by the phrase *restricted and repetitive behaviors*, a phrase that mostly misjudges the critical *necessity* of those behaviors. Whereas non-autistic children can gain their sensory grounding through an interest in all things human—that is, via conspecific perception—autistic children must gain their sensory grounding through an intense focus on the non-biological structural features that stand out from the surrounding environment. Thus, most autistic children today owe their developmental start primarily to an alternative form of perception.

8. *The significant presence of autistic individuals within the human population modifies the perceptual characteristics of the population as a whole, thereby breaking the stasis imposed by biological and conspecific perception*. Through their repeated efforts to mirror and to reconstruct the contextual patterns they perceive, autistic individuals bring to the foreground the structural elements and structural potential to be found in the surrounding environment. Non-autistic individuals, previously blinded to these structural elements by the constrictions of biological and conspecific perception, yet keenly aware of what other humans do, begin to notice these autistically inspired patterns and behaviors, and begin to adopt them for themselves. In this fashion, the entire human species begins to perceive and to interact with the surrounding environment in a manner that goes beyond just biological and evolutionary need, thereby opening the door to behaviors unique within the animal kingdom and unprecedented over the course of biological history.

9. *The human turn towards behavioral modernity, including the revolutionary advancement in human knowledge, has been catalyzed by the ongoing symbiosis between the non-autistic and autistic forms of perception.* As humans have gained a growing awareness of the structural potential contained within their surrounding environment, they have increasingly reconstructed that environment in countless and complex ways. These artificial innovations embody the advancements in human understanding and carry forward their structural underpinnings to future generations, leading to the multi-faceted and intricate surroundings in which people live today. Human experience now reflects a thorough blending of its two major sources of influence: one, the social, biological and communal aspect that arises out of humanity's animal past, and two, the artificial, structural and revolutionary aspect that has been introduced via the presence of the autistic population.

This description of autism illuminates the essential tension underlying scientific revolutions, with each pole of that tension corresponding to a particular perceptual type. Biologically typical perception underlies the communal and conservative qualities that define the normal science of stable paradigms, and autistic perception sparks the idiosyncratic and iconoclastic inspirations that drive abductive-style paradigm shifts in scientific revolutions. Both poles of this tension play a critical role in the maintenance and advancement of human understanding, with the non-autistic tendencies of normal science serving to buttress and to promulgate knowledge already gained, and with the autistic tendency towards atypical perception serving to demolish and to reconstruct knowledge in need of transformation.

5. The Atypical Individuals of Scientific Revolutions

It is important to recognize that in the modern world there is really no such thing as a purely non-autistic or purely autistic adult individual. Each person has a natural preference—determined mostly by how that person first achieved a sensory grounding—but as each individual matures, he or she will be exposed to a human environment now thoroughly suffused with both biological/social influences and also with artificial/structural influences, and will through this exposure gain increasing familiarity and dexterity with both the non-autistic and autistic perceptual traits. This is why a non-autistic individual can become extremely fluent in all manner of artificial and structural endeavor, and it is also why an autistic individual can achieve closer connection to the human species and become accomplished within the social realm. And in scientific practice, no individual is precluded from either of the counterbalancing roles—each individual is capable of engaging in normal science or in scientific revolution or in both. The distinction is at the perceptual level and not at the level of the individual.

Nonetheless, it can still be expected as a general rule that each individual will gravitate more frequently to his or her natural perceptual stance. For instance, the non-autistic individual is more likely to feel at home in the presence of other people, and the non-autistic scientist is more likely to be drawn to the communal and conservative aspects of normal science. At the same time, the autistic individual is more apt to take solitary comfort in the regularity of structured surroundings, and the autistic scientist is more apt to be drawn to the worldview-altering potential of abductive reasoning. Thus, it can also be expected that over the course of scientific history, the aha moments of scientific revolution will have been generated more frequently by individuals giving evidence of possessing autistic-like traits. And indeed, scientific history gives abundant evidence that this is in fact the case.

Newton, Einstein, Darwin, Cavendish, Dalton, Dirac, the Curies—the personalities that emerge from the biographies of such individuals stand out in several respects, including being remarkably similar to one another and being classifiable by a telltale collection of personal traits: shy, taciturn, socially awkward, intensely focused, late talking, habitual in routine, echolalic, etc. (James, 2003). Indeed, there is not one social butterfly to be found anywhere upon this list. Autism was not a known concept when these individuals lived, but if they were among the population today, their spectrum-like characteristics would be difficult to ignore. This is not a definitive proof that autism can be directly applied to such individuals or that autism was solely responsible for their innovative feats—retrospective application of autism should always be approached with caution and care. But the consistency in the atypical traits of so many individuals has to be more than mere coincidence, and at any rate, the hypothesis can still be put to a future test. There will be future aha moments, and there will be future knowledge revolutions, and with autism now more recognizable within the population, it will be worth some effort to observe how many of these future cases of knowledge revolution come with autism lingering conspicuously nearby.

Although it has become customary to explain the atypical characteristics of history's scientific icons as the by-product of their prodigious genius, there is in fact no reason not to consider the opposing explanation, that the cause and effect at work here actually runs in reverse.

6. The Structure of Scientific Stagnation

The normal science depicted in Kuhn's 1962 work reflects a remarkably keen eye for the scientific practice of Kuhn's day. Having originally studied to be a practicing scientist himself, Kuhn manages to capture accurately the many mechanisms helping to form and to maintain the scientific community of the 1950s and 1960s: conferences, textbooks, journals, academic associations, specialty groups, and so on. Unfortunately, Kuhn then seems to apply this milieu to much earlier times, with an intimation that Newton, Darwin, Einstein and others performed their work under similar circumstances. This is an anachronism.

Before the twentieth century, *scientific community* had a much different meaning than it had for Kuhn, or than it has today. During those earlier times, scientists worked almost exclusively as individuals, and sometimes in great isolation. Textbooks were essentially nonexistent, and journals were used not for publication acclaim but instead as a more efficient means of sharing results and ideas than could be had through the redundancy of multiple correspondences. Scientific associations, such as the Royal Society, were relatively few in number, and by and large they kept their doors open to the public, serving as an opportunity for both enthusiasts and dabblers to come together (Schofield, 1963).

Science was not then a lucrative profession, in fact quite the opposite. The biographies from those earlier times are filled with anecdotes about struggling to make ends meet and about entering the profession against the express wishes of family, more in favor of the financial security to be had with something like business or law. To be a scientist back then was to be literally not normal, and thus it would not have been surprising to find science's ranks permeated with a fair number of atypical individuals.

Those circumstances began to change during the late nineteenth century, and that change accelerated rapidly at the beginning of the twentieth century. Spurred by the needs of both war and commerce, governments and businesses alike began putting much greater value on scientific work, elevating the profession to both higher status and higher pay (Agar, 2012). This attracted a different kind of scientist, one who would not have been comfortable at all within a neglected isolation, but who was perfectly at home inside a lauded and burgeoning crowd. Scientists now worked less frequently as individuals and began forming into ever-enlarging teams. Scientific method transitioned into codified standards of practice. And scientific associations became more insular and more elite. This was the scientific community Kuhn was intimately familiar with, still with a hint of maverickness from its former days of revolutionary glory, but also settling rapidly into the large and regulated practice Kuhn identified as normal science. What Kuhn did not seem to appreciate was that this particular form of normal science was only recent in its origin, and was not applicable to earlier times, and this led also to Kuhn failing to anticipate that this form of normal science would become increasingly rigid, entrenched, and homogenous by the end of the twentieth century.

Whereas science prior to the 1900s was receptive to an autistic-like individual, the science of the 2000s has become a hegemony of the biologically typical. Its ranks are now overflowing with the decidedly non-autistic, and almost every aspect of modern science serves to foster the communal and the conservative. Affixation to a research team is currently *de rigueur*. Publication has become a mass competition for citations. And success is measured primarily in the size of research grants. In such a system, there is no place for an autistically minded individual to find a productive or comfortable home. Not in the selection of the most well-connected mentor upon entering graduate school. Not in the paying of homage to one's superiors through a stream of obsequious references. Not in the groupthink sessions of one's ever-present team. The autistically minded individual, the one who has a natural proclivity for those individualistic aha moments of abductive reasoning, that individual has been systematically elbowed out from the community, or else has been forced to subsume his or her tendencies under a mountain of normative rules. Try to imagine a young patent office clerk with a nonconforming notion about space and about time, try to imagine that individual getting published today, or being noticed by the scientific community at all.

The consequence of this transformation has been of course inevitable—the notion of scientific revolution has almost entirely disappeared. It is not apparent that there has been *any* notable knowledge innovation over the last seventy-five years, and it seems every current form of scientific endeavor is in a state of being perpetually stuck. Consider human intelligence research and its continuing befuddlement over the Flynn effect. Consider autism science and its ongoing obsession with medical cause. Consider that king of the sciences, the domain of physics, and its endless dysfunctional marriage with string theory. Or try this: browse the historical list of Nobel prizes, a list that in the early 1900s was marked with the individual names of Planck, Bohr, Rutherford, de Broglie and Einstein, and in the early 2000s has turned into an annual celebration of research teams and academic press releases.

Fortunately, humanity need not despair over these circumstances. There will still be knowledge revolutions and there will still be constructive advancement in human understanding, even if those revolutions and that advancement must come from someplace else than the scientific community. Or perhaps that community will come to recognize its current state of crisis and will begin the search for a self-correcting paradigm shift. The exact details of such a shift remain uncertain, but its general course can be anticipated: a return to something more akin to former productive times, when there was still the essential tension between science's two counterbalancing poles, when there was still a symbiotic relationship between the non-autistic and autistic forms of perception.

References

Agar, J. (2012). *Science in the Twentieth Century and Beyond*. Cambridge: Polity.

Asperger, H. (1944) Die "Autistischen Psychopathen" im Kindesalter. [The "Autistic Psychopaths" in Childhood]. *Archiv für Psychiatrie und Nervenkrankheiten, 117*, 76-136. https://doi.org/10.1007/BF01837709

Baker, D. P., Eslinger, P. J., Benavides, M., Peters, E., Dieckmann, N. F., & Leon, J. (2015). The cognitive impact of the education revolution: A possible cause of the Flynn Effect on population IQ. *Intelligence, 49,* 144–158. https://doi.org/10.1016/j.intell.2015.01.003

Ballan, M. S., & Hyk, J. C. (2019). Autism spectrum disorders. In J. C. Raines (Ed.), *Evidence-based practice in school mental health: Addressing DSM-5 disorders in schools* (pp. 91–130). Oxford University Press. https://doi.org/10.1093/oso/9780190886578.003.0003

Barber, B. (1961). Resistance by scientists to scientific discovery. *Science (New York, N.Y.), 134*(3479), 596–602. https://doi.org/10.1126/science.134.3479.596

Buxton, V. L., Enos, J. K., Sperry, J. H., & Ward, M. P. (2020). A review of conspecific attraction for habitat selection across taxa. *Ecology and evolution*, *10*(23), 12690–12699. https://doi.org/10.1002/ece3.6922

Campos, D. G. (2011). On the distinction between Peirce's abduction and Lipton's Inference to the best explanation. *Synthese*, *180*(3), 419–442. https://www.jstor.org/stable/41477565

Cattane, N., Richetto, J., & Cattaneo, A. (2020). Prenatal exposure to environmental insults and enhanced risk of developing Schizophrenia and Autism Spectrum Disorder: focus on biological pathways and epigenetic mechanisms. *Neuroscience & Biobehavioral Reviews*, *117*, 253-278. https://doi.org/10.1016/j.neubiorev.2018.07.001

Clark, C. M., Lawlor-Savage, L., & Goghari, V. M. (2016). The Flynn effect: A quantitative commentary on modernity and human intelligence. *Measurement: Interdisciplinary Research and Perspectives, 14(2)*, 39–53. https://doi.org/10.1080/15366367.2016.1156910

Dickens, W. T., & Flynn, J. R. (2001). Heritability estimates versus large environmental effects: the IQ paradox resolved. *Psychological review*, *108*(2), 346–369. https://doi.org/10.1037/0033-295x.108.2.346

Earman, J., Glymour, C., & Rynasiewicz, R. (1982). On Writing the History of Special Relativity. *PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association*, *1982*(2), 403–416. https://doi.org/10.1086/psaprocbienmeetp.1982.2.192433

Einstein, A. (1905). On the Electrodynamics of Moving Bodies. *Annalen der Physik, 17*, 891-921.

Evans B. (2013). How autism became autism: The radical transformation of a central concept of child development in Britain. *History of the human sciences*, *26*(3), 3–31. https://doi.org/10.1177/0952695113484320

Flynn, J. R. (1984). The mean IQ of Americans: Massive gains 1932 to 1978. *Psychological Bulletin, 95*(1), 29–51. https://doi.org/10.1037/0033-2909.95.1.29

Flynn, J. R. (1987). Massive IQ gains in 14 nations: What IQ tests really measure. *Psychological Bulletin, 101*(2), 171–191. https://doi.org/10.1037/0033-2909.101.2.171

Goldberg, S. (1970). In Defense of Ether: The British Response to Einstein's Special Theory of Relativity, 1905-1911. *Historical Studies in the Physical Sciences*, *2*, 89–125. https://doi.org/10.2307/27757305

Griswold, A. (2007). *Autistic Symphony*. iUniverse. (accessible online: https://www.grizzalan.com/autisticsymphony)

Griswold, A. (2023). *Autistic Rhapsody*. iUniverse. (accessible online: https://www.grizzalan.com/autisticrhapsody)

Haas, R. H., Townsend, J., Courchesne, E., Lincoln, A. J., Schreibman, L., & Yeung-Courchesne, R. (1996). Neurologic abnormalities in infantile autism. *Journal of child neurology, 11*(2), 84–92. https://doi.org/10.1177/088307389601100204

Hazen, E. P., Stornelli, J. L., O'Rourke, J. A., Koesterer, K., & McDougle, C. J. (2014). Sensory symptoms in autism spectrum disorders. *Harvard review of psychiatry*, *22*(2), 112–124. https://doi.org/10.1097/01.HRP.0000445143.08773.58

Hedger, N., & Chakrabarti, B. (2021). Autistic differences in the temporal dynamics of social attention. *Autism : the international journal of research and practice*, *25*(6), 1615–1626. https://doi.org/10.1177/1362361321998573

Hodges, H., Fealko, C., & Soares, N. (2020). Autism spectrum disorder: definition, epidemiology, causes, and clinical evaluation. *Translational pediatrics*, *9*(Suppl 1), S55–S65. https://doi.org/10.21037/tp.2019.09.09

James I. (2003). Singular scientists. *Journal of the Royal Society of Medicine*, *96*(1), 36–39. https://doi.org/10.1177/014107680309600112

Jensen, A. R. (1998). *The g factor: The science of mental ability*. Praeger Publishers/ Greenwood Publishing Group.

Jung, R. E., & Haier, R. J. (2007). The Parieto-Frontal Integration Theory (P-FIT) of intelligence: converging neuroimaging evidence. *The Behavioral and brain sciences*, *30*(2), 135–187. https://doi.org/10.1017/S0140525X07001185

Kaiser, D. (2012). In retrospect: The Structure of Scientific Revolutions. *Nature,* 484, 164–165. https://doi.org/10.1038/484164a

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child, 2,* 217–250.

Kern, J. K., & Jones, A. M. (2006). Evidence of toxicity, oxidative stress, and neuronal insult in autism. *Journal of toxicology and environmental health. Part B, Critical reviews, 9*(6), 485–499. https://doi.org/10.1080/10937400600882079

Kern, J. K., Trivedi, M. H., Garver, C. R., Grannemann, B. D., Andrews, A. A., Savla, J. S., Johnson, D. G., Mehta, J. A., & Schroeder, J. L. (2006). The pattern of sensory processing abnormalities in autism. *Autism : the international journal of research and practice*, *10*(5), 480–494. https://doi.org/10.1177/1362361306066564

Klein, R. (2002). *The Dawn of Human Culture*. New York: Wiley.

Klein, R. G. (2009). *The human career: Human biological and cultural origins*. University of Chicago Press.

Kuhn, T. S. (1962). *The structure of scientific revolutions*. University of Chicago Press: Chicago.

Kuhn, T. S. (1978). The essential tension. *Philosophy of Science* 45 (4):649-652.

Lorentz, H. A. (1904). Electromagnetic phenomena in a system moving with any velocity less than that of light. *Proc. Acad. Science Amsterdam, IV*, 669–78.

Lycke, H. (2012). A Formal Explication Of The Search For Explanations: The Adaptive Logics Approach To Abductive Reasoning. *Logic Journal of the IGPL* 20 (2):497-516.

Lynn, R. (1989). A nutrition theory of the secular increases in intelligence; positive correlations between height, head size and IQ. *British Journal of Educational Psychology, 59(3)*, 372–377. https://doi.org/10.1111/j.2044-8279.1989.tb03112.x

Masterman, M. (1970). The Nature of a Paradigm. In Lakatos, I. & Musgrave, A. (Eds.) *Criticism and the Growth of Knowledge.* London, Cambridge University Press.

Mcauliffe, (2015). How did Abduction Get Confused with Inference to the Best Explanation? Transactions of the Charles S. Peirce Society 51 (3):300-319. https://doi.org/10.2979/trancharpeirsoc.51.3.300

Michelson, A. A, & Morley E. M. (1887). On the relative motion of the Earth and the luminiferous ether. *American Journal of Science, 34*(203), 333–345.

O'Reilly, M., Lester, J.N., Kiyimba, N. (2020). Autism in the Twentieth Century: An Evolution of a Controversial Condition. In: Taylor, S.J., Brumby, A. (eds) Healthy Minds in the Twentieth Century. Mental Health in Historical Perspective. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-27275-3_7

Pan, P. Y., Bölte, S., Kaur, P., Jamil, S., & Jonsson, U. (2021). Neurological disorders in autism: A systematic review and meta-analysis. *Autism : the international journal of research and practice, 25*(3), 812–830. https://doi.org/10.1177/1362361320951370

Park, W. (2015). On classifying abduction. *Journal of Applied Logic 13 (3):*215-238. https://doi.org/10.1016/j.jal.2015.04.001

Peirce, C. S. (1992). *The Essential Peirce, Volume 1: Selected Philosophical Writings (1867–1893).* Indiana University Press. https://doi.org/10.2307/j.ctvpwhg1z

Peirce, C. S. (1998). *The Essential Peirce, Volume 2: Selected Philosophical Writings (1893-1913).* Indiana University Press. https://www.jstor.org/stable/j.ctt16gz4vr

Pietschnig, J., & Voracek, M. (2015). One Century of Global IQ Gains: A Formal Meta-Analysis of the Flynn Effect (1909–2013). *Perspectives on Psychological Science*, 10(3), 282-306. https://doi.org/10.1177/1745691615577701

Poincaré, H. (1900). The theory of Lorentz and the principle of reaction. *Archives neerlandaises*, V, 252-78.

Reis, S. M., Gelbar, N. W., & Madaus, J. W. (2022). Understanding the Academic Success of Academically Talented College Students with Autism Spectrum Disorders. *Journal of autism and developmental disorders*, *52*(10), 4426–4439. https://doi.org/10.1007/s10803-021-05290-4

Reiss, A. L., Feinstein, C., & Rosenbaum, K. N. (1986). Autism and genetic disorders. *Schizophrenia bulletin*, *12*(4), 724–738. https://doi.org/10.1093/schbul/12.4.724

Rylaarsdam, L., & Guemez-Gamboa, A. (2019). Genetic Causes and Modifiers of Autism Spectrum Disorder. *Frontiers in cellular neuroscience*, *13*, 385. https://doi.org/10.3389/fncel.2019.00385

Sanbonmatsu, D. M., & Sanbonmatsu, K. K. (2017). The Structure of Scientific Revolutions: Kuhn's misconceptions of (normal) science. *Journal of Theoretical and Philosophical Psychology, 37*(3), 133–151. https://doi.org/10.1037/teo0000059

Schofield, R. E. (1963). Histories of Scientific Societies: Needs and Opportunities for Research. *History of Science*, *2*(1), 70-83. https://doi.org/10.1177/007327536300200104

Schurz, G. (2008). Patterns of Abduction. *Synthese*, *164*(2), 201–234. http://www.jstor.org/stable/40271057

Stachel, J. J. (2002). *Einstein from "B" to "Z"* / John Stachel. Birkhäuser.

Trahan, L. H., Stuebing, K. K., Fletcher, J. M., & Hiscock, M. (2014). The Flynn effect: a meta-analysis. *Psychological bulletin*, *140*(5), 1332–1360. https://doi.org/10.1037/a0037173

Urbański, M. (2022). Evaluation of Abductive Hypotheses: A Logical Perspective. In: Magnani, L. (eds) Handbook of Abductive Cognition. Springer, Cham. https://doi.org/10.1007/978-3-030-68436-5_23-1

Woodley, M. A. (2012). A life history model of the Lynn-Flynn effect. *Personality and Individual Differences, 53*, 152-156. https://doi.org/10.1016/j.paid.2011.03.028

Prototypical Autism Is Transformatively Atypical

Abstract

The depiction of prototypical autism as presented by Laurent Mottron's research team is a promising concept with a few notable shortcomings. The Mottron team's depiction does provide a lucid and useful outline of what autism tends to look like close at hand, and furthermore, this depiction posits a positive framework for regarding autism as a non-defective and viable branch of human development, championing the constructive use of autistic characteristics to support developmental progress. Nonetheless, the notion of prototypical autism could be improved by taking a more specific approach to explaining atypical autistic perception, incorporating the idea of *conspecific perception* to delineate more clearly the non-autistic and autistic perceptual traits. Also, prototypical autism could be recognized as outlining perceptual and behavioral characteristics that mirror the perceptual and behavioral characteristics standing at the foundation of humanity's turn towards behavioral modernity, highlighting autism's role in the ongoing mechanisms of human transformation. Given the Mottron team's silence on this latter idea, this essay concludes with some thoughts on how the conventional practices of modern science preclude researchers from taking a more revolutionary approach to their endeavors.

1. Introduction

Laurent Mottron, an autism researcher based in Montreal, Canada, along with various colleagues and co-authors (hereafter referred to as the Mottron team), has of late introduced and promoted a concept called *prototypical autism*. Although this concept was hinted at in earlier writings, its main presentation has come in the form of two recent papers. The first paper, *A radical change in our autism research strategy is needed: Back to prototypes* (Mottron, 2021a), addresses the motivation for delineating prototypical autism from other instances of autism diagnosis, a motivation triggered mostly by concerns over the statistical noise produced by too much heterogeneity within autism research cohorts. The second paper, *Prototypical autism: New diagnostic criteria and asymmetrical bifurcation model* (Mottron & Gagnon, 2023), outlines in some detail the Mottron team's description of how to recognize prototypical autism among the population and how to distinguish such cases from other forms of autism diagnosis.

There is much to appreciate about this initiative. The highlight of the Mottron team's effort is to be found in the team's general description of how prototypical autism presents, especially during the critical age range of around two to five years. The behavioral characteristics outlined in this description are more accurate, more comprehensive and more vivid than can be found in any of the official diagnostic guidelines, painting an informative picture of what autism tends to look like close at hand. To this can be added the Mottron team's twofold awareness of the potential to be found in the unusual characteristics of autistic individuals, first with an emphasis on the fact that autistic children can often make significant gains by *leaning into* their unusual interests, as opposed to being forced to *suppress* them, and second, by reconceptualizing autism as a non-defective and viable branch of human development, including an explicit acknowledgement that many autistic children go on to live relatively normal and even exceptional lives *after* the age of five. Over the years, the Mottron team has been one of the few autism research teams (perhaps the only autism research team) willing to contemplate and to discuss the potential value arising out of autistic atypicality, and that willingness remains on display here.

Nonetheless, there are some shortcomings in the Mottron team's effort, two of which stand out in particular. First, although the Mottron team does recognize the critical importance of perception in distinguishing autistic individuals from their non-autistic counterparts, the team's characterization of these two different forms of perception is confusing at best, with a vague reference to the "social bias" of non-autistic children and an incongruous reference to the "enhanced perceptual functioning" of autistic children. These phrases fail to distinguish clearly the two perceptual types, but more importantly, they fail to explain *why* there is a perceptual difference between non-autistic and autistic children. This essay will discuss a more specific and more informative approach to making that distinction, employing the concept of *conspecific perception*—the innate tendency to perceive first and foremost the other members of one's own species—as the primary means both for delineating the non-autistic and autistic perceptual traits, as well as for explaining the contrasting genesis of each perceptual type.

The second shortcoming of the Mottron team's initiative is its complete silence regarding prototypical autism's impact upon the entire human species. The stated motivation for developing the concept of prototypical autism—to improve the statistical power of current autism research—overlooks the possibility that there is a much bigger picture to consider here, one of importance to autistic individuals themselves. This essay will discuss humanity's turn towards behavioral modernity, including the perceptual and behavioral transformations that stand at the foundation of that turn, and will demonstrate that these transformations are mirrored precisely in the Mottron team's contrasting description of the non-autistic and autistic perceptual and behavioral traits. That is to say, the atypicality of autistic individuals within the human population explains much about the atypicality of the human species itself, now perceptually and behaviorally removed from the remainder of the animal kingdom, and perceptually and behaviorally removed from humanity's own not-so-distant animal past. If autistic individuals are going to be understood for who they actually are, and if their unusual characteristics are going to be valued for the impact they actually bring, then autistic contribution to human transformative history needs to be recognized. And although the Mottron team has all the information it requires to make that connection, it chooses not to consider the topic at all.

It might be stated in the Mottron team's defense that contemplating the conceptual leap from autistic traits to the transformative characteristics of the human behavioral turn goes beyond the jurisdiction of normal autism science. But the problem with this defense is that it dooms autism science to a self-imposed tunnel vision, a kind of group myopia that has been producing endless decades of null results (Myers et al., 2020; Parellada et al., 2023; Whitehouse et al., 2021). Accordingly, this essay will conclude with some thoughts on the stultifying consequences of modern scientific practice, where focus has shifted entirely towards cultivating professional and collaborative craft—standards and guidelines, grants and funding, credentials and citations, etc.—and has abandoned the type of individualistic and revolutionary effort that used to produce breakthroughs of understanding. Thus, it can be seen that the most significant problem with autism research today, including that of the Mottron team, is not one of statistical noise. The most significant problem with autism research today is its perfunctory application of normal autism science.

2. Prototypical Autism

A rough summary of the Mottron team's description of a prototypically autistic child would include the following features:

1. The autistic child is generally indistinguishable from non-autistic children until sometime during the second year of life. Around the second birthday, the difference from typical development becomes pronounced and remains pronounced for at least the next two to three years.
2. During this period of around two to five years of age, the autistic child will display a significantly low degree of orientation towards social stimuli. This includes a diminished attention to human faces and to human voices, and also includes a noticeable lack of joint-attentive activities and human-mimicking behavior.
3. During this period, the autistic child will also display a high degree of orientation towards structural and environmental stimuli. This includes a focused attention on such things as patterned

movement, geometrical objects, repetitive and/or musical sounds, the shapes of numbers and letters, etc.

4. During this period, language skills plateau, or even regress, resulting in a limited vocabulary and extremely limited sentence formation. Language peculiarities, such as echolalia and pronoun reversal, are also apparent in many instances.
5. During this period, certain unusual and telltale behaviors are more commonly seen, such as lateral gaze, hand flapping, food selectivity, resistance to change, etc.
6. After this period, there is usually some degree of developmental catch up, both in social orientation and language ability. This developmental catch up can vary greatly, resulting in outcomes that range all the way from non-verbalness in adulthood and a lifetime need for assistance and care, to promising prospects of advanced education, career, family, etc., with many prototypically autistic individuals experiencing outcomes that fall somewhere on the interval between.

In advocating for its concept of prototypical autism, the Mottron team notes that there are a significant number of individuals who will receive an autism diagnosis under the current official diagnostic guidelines but who will tend not to have a presentation that follows the pattern as outlined above. There appear to be three major sub-categories of these individuals who could be described as being non-prototypical:

1. *Individuals with specifiable neuro-genetic conditions*. This would include such known instances as fragile X syndrome, Rett syndrome, identifiable *de novo* mutations, or a medical history giving evidence of neurological trauma. Such individuals will often display similarities to autistic-like behavior, but will also tend to deviate significantly from a course of prototypicality, either in intensity, timing or both.
2. *"Quirky" or behaviorally challenged individuals who possess only a smattering of autistic-like traits*. Many children are referred to specialists because of their developmental and/or behavioral challenges, and due to the current latitude in the official autism

diagnostic guidelines, such individuals will often receive a diagnosis of being on the autism spectrum. But a large number of these individuals will not follow the prototypical course—that is, they will display a reasonable degree of social orientation, or will have limited structural and environmental engagement, or will give evidence of language skills that are progressing in the usual way. The Mottron team argues that such individuals are better excluded from certain types of autism research (Mottron & Bzdok, 2022).

3. *Asperger-like individuals*. This forms a less clearcut case. Until around a decade ago, *Asperger Syndrome* was an official diagnostic category, intended to delineate children with pronounced autistic-like characteristics but who also possessed notable language skills. This diagnostic distinction proved to be unworkable in practice, and the classification was dropped for the current diagnostic manual (Gamlin, 2017). Nonetheless, there are a significant number of children who appear to fall within this category, and their relationship to the remainder of the autism spectrum remains unclear. The Mottron team suggests these individuals could be formed into a second "prototypical" group (Mottron, 2021b), with characteristics similar to those of the first prototypical group but without the language plateau or regression. However, it could be argued that Asperger-like children are simply choosing linguistic structures as one of their preferred circumscribed interests—that is, instead of an intense focus on something like ceiling fans or calendar calculation, Asperger-like children choose to concentrate on spoken and/or written words. This is evidenced to some degree by the fact that Asperger-like language skills are usually not typical (Saalasti et al., 2008); that is, Asperger-like children do not employ language primarily for social purposes but instead make use of language in idiosyncratic ways (for example, in perseveration). If this is an accurate depiction of what is actually taking place, then it would appear these two prototypical groups are far more similar than dissimilar, and the Mottron team's separation of Asperger-like children from the team's main prototypical definition is perhaps just a case of splitting hairs.

What does finally emerge from the Mottron team's lucid description of prototypical autism is a class of individuals remarkably similar to one another and yet identifiably distinct from the biologically typical population. Furthermore, this is a class of individuals who have been giving no evidence of possessing any underlying defect—not genetic, not neurological, not environmentally caused—and this despite the fact the autism research community has been assiduously searching for these defects for dozens of years. The Mottron team highlights this apparent biological benignity of prototypical autism by suggesting the condition would be more effectively understood as a minority but otherwise normal bifurcation of human development, analogous to similar asymmetrical bifurcations, such as left-handedness or twin pregnancy. This opens the door to embracing autistic characteristics for their potential constructive value, including making full use of these characteristics to support developmental progress. Such a viewpoint stands in stark contrast to the standard approach taken towards autistic traits, where these traits are routinely suppressed instead of being productively employed, suppressed through an assortment of disruptive interventions that would appear to be no more effective than attempting to turn left-handedness into right-handedness (Brignell et al., 2018; Sandbank et al., 2020).

3. Atypical Autistic Perception

In attempting to explain the source of the bifurcation between non-autistic and autistic individuals, the Mottron team highlights the differential targets of interest and attention during information processing, assigning a label of "socially biased processing" for the preferential interests of non-autistic children and a label of "non-socially biased processing" for the preferential interests of autistic children. The Mottron team also tends to reserve use of the words *perception* and *perceptual* for the latter type of preferential interest, and this leads in turn to frequent employment of the phrase "enhanced perceptual functioning" to describe autistic cognitive traits. This approach appears to be confusing in several respects. First, it implies that non-autistic children lack perceptual characteristics, or at the very least are experiencing *diminished* perceptual functioning. It also suggests that autistic children possess a kind of fortuitous brain capacity that gives them perceptual skills beyond those of ordinary experience (Poulin-Lord et al., 2014), and yet somehow this fortuitous brain capacity also proves disruptive to developmental progress. Although the Mottron team's highlighting of information processing and perceptual characteristics is very much on target, the team's odd labeling works to derail the discussion. Under any commonsense use of the words *perception* and *enhanced*, it would be difficult to reconcile the phrase "enhanced perceptual functioning" to the developmental pathways of autistic individuals.

For the purpose of this discussion, *perception* is to be understood as the filtering, foregrounding, and organization of the manifold of impressions arising from the sensory field. Perception creates targets of cognitive attention and provides the potential for a directed and productive reaction to environmental stimulus. Consider the example of three men sitting together in the grandstands at a football game. One man is intently following the plays on the field, scarcely aware of the crowd—he can accurately predict the play that is coming next. The second man is mesmerized by the workings of the scoreboard—he is counting down in his head the seconds until the yardage and downs are updated. The third man is flitting a gaze from person to person—cheerleader, then referee, then that cute snuggling couple three rows down—and he would be unable to tell you the score of the game if his life depended on it. Each individual has access to the exact same sensory stimuli, but each individual *perceives* something entirely different, foregrounding certain aspects of the sensory experience and backgrounding everything else. This is a commonsense approach to the word *perception*, and by its means, it should be abundantly clear that *both* non-autistic and autistic individuals possess perceptual characteristics, with *neither* of those perceptual types being ultimately enhanced or diminished relative to the other. Given the same sensory environment, non-autistic and autistic individuals simply tend to perceive different classes of things.

The genesis of each perceptual type begins in earnest by the second year of life. When human newborns enter this world, they must soon achieve a sensory grounding, because otherwise the manifold of sensory impressions would remain chaotic and unorganized, thwarting all effort towards productive action and developmental progress. The emerging components of this sensory grounding are what determine the perceptual type. For both non-autistic and autistic individuals, biological demand will bring certain environmental features to the fore—that is, the need for food and water, a fear of danger, and eventually the desire for sex will bring into cognitive attention certain ecologically critical aspects of the surrounding world, providing some of the means by which sensory experience can be differentiated and organized. As the Mottron team notes, prototypically autistic individuals give little to no evidence of having a diminished capacity in these basic biological domains, even when life circumstances cause the expression of these capacities to be manifested in alternative ways.

What does turn out to be the distinguishing characteristic between the non-autistic and autistic types of perception is that non-autistic perception is fundamentally human centric, and autistic perception is not. From out of the manifold of sensory impressions, what tends to foreground naturally and frequently for non-autistic individuals are human faces, human voices, human touch, human smells, human laughter, human activities, etc. Non-autistic children provide abundant evidence of their human-forward attentive awareness, responding with consistent delight to human interaction, joint-attentive sharing, and people-mimicking behavior. Even when their attention is drawn to the non-human aspects of the surrounding environment, it is usually done so through the means of human prompting and human encouragement. Thus, in addition to its basic biological components, non-autistic perception can be characterized by its human-forward content, meaning that non-autistic children tend to organize their sensory experience primarily around the species itself, and around the species' shared and natural interest in all things human.

There is of course nothing unusual about this non-autistic perceptual tendency. The foregrounding of species-specific sensory experience is not just typical within the human population, it is typical across the entire animal kingdom (Lickliter, 1991; Nunes et al., 2020). Lions tend to perceive first and foremost other lions, honeybees tend to perceive first and foremost other honeybees, etc. This widespread tendency can be given the label of *conspecific perception*, and it can be defined as the innate tendency to perceive first and foremost the other members of one's own species. Conspecific perception's ubiquitous appearance throughout nature can be attributed to biological and evolutionary necessity. If mates are going to be able to recognize and discover mates, if parents are going to be able to keep track of their offspring, if members of a pack are going to be able to follow one another, then a foregrounded perceptual attention for the other members of one's own species is nothing short of essential. Conspecific perception has evolutionary roots that reach very far back in time, and conspecific perception is one of the more prominent carryovers from humanity's not-so-distant purely animal past.

With this as backdrop, autistic perception can be characterized as a significant diminution of conspecific perception. Autistic children—by the Mottron team's own definition of prototypical autism—do not have a natural and favored interest for human faces, human voices, human touch, etc., and autistic children do not frequently engage in human interaction, joint-attentive sharing, or people-mimicking behavior. There are two different approaches to depicting this autistic diminution of conspecific perception. As the Mottron team would have it, the characteristics of autistic perception arise from a strong and positive interest in the non-socially biased and raw informational aspects of various environmental features (Mottron et al., 2006). This "enhanced perceptual" interest is the result of a presumed alternative neural-cognitive mechanism (Kéïta et al., 2011; Mottron et al., 2014; Soulières et al., 2009), and its effects are powerful enough to eclipse the usual people-focused foregrounding of conspecific perception. Although this depiction is not an unreasonable hypothesis, it does appear to lack for parsimoniousness. Not only must this explanation postulate a special and mostly unspecified neural-cognitive mechanism, that mechanism must also be capable of producing for each autistic individual a particular and distinctive set of interests chosen from an extremely broad range of perceptual targets. Some autistic children are focused primarily on the auditory domain, others on the tactile domain, and still others on the visual domain. Some autistic children concentrate on geometric objects, such as ceiling fans and lined-up toys, while others concentrate on the repetitions of music and television scenes, while still others hone in on the properties of numbers, letters and words. What brain mechanism, special within the species, could produce such a selectively targeted set of interests across such a motley range of potential targets? And furthermore, why should it be expected that this "enhanced" brain mechanism would drown out the usual conspecific attachment to the other members of the species? If a population were almost entirely right-handed, but a portion of that population had special neural abilities to make extra use of the left hand, why should these special abilities result in exclusive left-handedness, why not instead ambidextrousness? If autistic children have a special neural ability to engage with the non-socially biased aspects of the surrounding environment, why should this special ability preclude their willingness to engage in the usual ways with other people?

The alternative approach to depicting autistic diminution of conspecific perception would be to accept this diminution as a definitive and fundamental fact, and then work out the consequences from there. To begin, since autistic children do not possess as strong a sense of conspecific perception as non-autistic children do, autistic children are more in danger of experiencing an ongoing sensory chaos. For autistic children, human-centric features do not emerge prominently from the manifold of sensory impressions, and this means that, other than some basic biological components, sensory experience for autistic children has the potential of remaining unorganized and ungrounded, a near jumble of undifferentiated sensory noise. The potential for this sensory chaos is evidenced by the frequent reporting of sensory issues in autistic children (Hazen et al., 2014; Kern et al., 2006)—hypersensitivity, hyposensitivity, synesthesia—with the wide variety of these sensory symptoms suggesting they are not the result of a particular physical defect so much as they are the result of a generalized difficulty in organizing sensory experience. And indeed, it can be surmised that the most troubling cases of autism, those in which developmental progress remains minimal, are those cases in which the attainment of a sensory grounding is insufficient to support timely developmental gains.

Nonetheless, most autistic children do not become stuck inside a sensory chaos and most autistic children do go on to make significant developmental progress. Since conspecific perception is not providing the primary means by which sensory experience can be organized, autistic sensory grounding must be getting attained by some other means. *Chaos* as a term denotes a lack of structure, and chaos can be dispelled by the foregrounded presence of structural properties—symmetry, repetition, pattern, number, form. Needing a sensory grounding to dispel their potential sensory chaos, and lacking a natural human-forward attentive focus, autistic children begin to latch onto those structural features that inherently stand out from the surrounding environment, features that serve to break the background sensory noise. Note the *symmetry* of ceiling fans and lined-up toys, the *repetition* of flapping, humming and predictable routines, the *patterned* and *formal* properties of calendars and television shows, the *shapes* and *sequences* of numbers and letters. Autistic children provide abundant evidence of a structure-forward attentive focus, responding with consistent delight to artifact interaction, pattern-oriented exploration, and form-mimicking behavior. Each instance of an autistic child's so-called restricted and repetitive behavior is an instance thoroughly suffused with structural underpinning, and autistic children do not just *prefer* these mostly non-human structural experiences, autistic children *require* them—they are what serve to organize the autistic child's sensory world.

Thus, a special or enhanced neuro-cognitive mechanism is not needed to explain autistic perceptual characteristics. All that is needed is the diminution of conspecific perception, the requirement of a sensory grounding, and the presence of inherently structural features within the surrounding environment. The artificially constructed modern world contains an abundance of these structural targets, and it can be surmised that an autistic child latches onto his or her particular subset of these potential targets through a combination of personal proclivity and random exposure to particular environmental elements. For some it will first be ceiling fans and spinning wheels that emerge from the sensory field, for others it will be rhythmic and musical sounds, and for still others it will be numbers, letters and words. Any circumstance that an autistic child happens upon that boosts that child's sensory grounding will become a circumstance likely to be returned to again and again. And to increase the range of an autistic child's perceptual domain, frequent exposure to a wide variety of structural features, along with encouragement to explore freely, can only be beneficial (Jacques et al., 2018). This is the strongest argument that can be made for aiding the developmental progress of autistic children by *leaning into* their autistic characteristics, instead of mistakenly suppressing them.

In summary, the significant presence or diminution of conspecific perception determines the non-autistic and autistic perceptual types. Non-autistic perception has deep biological and evolutionary roots, continuing the species-specific perceptual focus evident throughout the entire animal kingdom and accounting for the non-autistic child's natural affinity for human interaction and human engagement. In contrast, autistic perception, lacking this influence of conspecific perception, produces little natural affinity for human interaction and human engagement, but in compensation nudges the autistic child to hone in on those structural features that inherently stand out from the surrounding environment, leading to a structure-forward perceptual focus. This distinction is most apparent during the critical age range of around two to five years. Sometime during this period for non-autistic children, and by the end of this period for autistic children, each perceptual type will begin to overlap with the other. Following the encouragement and instruction of the humans that fascinate them so much, non-autistic children will begin to explore a world of non-human structural features, thereby expanding their perceptual horizons and furthering their developmental course. At the same time, and with their sensory grounding now more firmly established, autistic children soon discover that many of the structural features they have taken such interest in also have human connections and human origins, and this discovery will eventually prompt a secondary interest in the workings of the species itself, including the leveraging powers of language and personal interaction. Given enough time and opportunity, both types of perception can become broadly effective.

Nonetheless, the difference in the genesis of each perceptual type is not to be ignored. There is great significance to the fact that one of these types of perception is biologically typical, and the other type of perception is thoroughly atypical. That distinction produces a tremendous impact upon the entire human population.

4. The Autistic Influence on Behavioral Modernity

The fascinating and stubborn question facing humanity is how did this species transform from being pure animal not more than a few hundred thousand years ago to being the modern creature observed today—talking, writing, calculating, constructing, innovating, driving, flying, and so on. What launched human behavioral modernity, and what sustains its operations today? Many vague suggestions centered around the concepts of evolution and brain intelligence mechanics are frequently tossed around (Klein, 2002; Pinker, 1994), but these suggestions clearly lack for specificity, seldom reaching the level of a detailed hypothesis. Furthermore, there is an obvious problem with the timeline. For sake of argument, assume that the beginning of the human behavioral turn happened around two hundred thousand years ago. By fifty thousand years ago, although the evidence of this turn was now unmistakable—control of fire, structured tools and weapons, cave paintings, etc.—human life was still extraordinarily primitive, a hunter-gatherer's bare subsistence, with virtually nothing of modern culture and technology to be found anywhere within the human environment (Christian, 2018). By ten thousand years ago, agriculture and civilizations were only on the verge of getting started, and by a mere five hundred years ago, the revolutionary impact of modern science had yet to be seen. Almost everything that humans experience today—electricity, fast transportation, effective medicines, vast stores of readily available information—nearly all this has appeared within only the last century or two. Thus, the human transformation has been continuous but it has never been uniform. The human transformation has instead been accelerating, and it continues to accelerate through the present day, its ongoing effects now experienced almost immediately population wide. Vague suggestions centered around the concepts of evolution and brain intelligence mechanics will never fit the dynamics of this unprecedented scenario.

A more effective answer is to be found in the extraordinary expansion of human perception. When humans were still in the state of being pure animals—a period of time lasting for millions of years—their perceptual characteristics would have been the same as those of all the other animal species. Responding to the pressing demands of biological and evolutionary need, human attentive focus would have been directed exclusively to those environmental features crucial for survival and procreation—food, water, danger, sex, etc. Within this biologically driven attentive focus would have been found also the workings of conspecific perception, allowing humans to foreground naturally and frequently the other members of their own species, a trait essential for the various activities promoting survival and procreation. For these ancient humans—as is the case for all the wild animal species—this powerful combination of biological and conspecific perception helped foster the continuation of the lineage, directing all attentive awareness and all resulting behavior towards the essential requirements of evolutionary demand.

However, there is a significant limitation that accompanies this type of perception. As humans have come to realize and to take advantage of in recent years, the surrounding environment contains a plenitude of inherent structure that can provide benefit to a species when used in the right way—for example, the linear forces of gravity, the patterned repetitions of celestial objects, the framework of numerical and symmetrical groupings, and so on. Yet despite these available benefits, no other animal species has ever displayed a perceptual awareness for any of these underlying structural features, and neither did humans for a very long time (Klein, 2009). The powerful combination of biological and conspecific perception is such that it locks each organism into a perceptual and behavioral stasis, leaving the organism fixated entirely on the immediate needs of survival and procreation, and utterly oblivious to everything else. This is why the perceptual and behavioral characteristics of all the wild animal species are so remarkably similar, both across species and across time. With each organism bound to the exact same way of perceiving its environment, each organism is bound also to the exact same set of responsive behaviors—eating and drinking, fighting and fleeing, mating and rearing. Each organism within the species, and each species within the animal kingdom, lives out essentially the same biologically driven existence, again and again and again. It is an existence determined primarily by the restricted attentive focus imposed by biological and conspecific perception.

Therefore, to explain the human turn towards behavioral modernity, it is necessary to explain how this perceptual and behavioral stasis has been broken within the species, and how this stasis has been replaced with the types of expanded perception and resulting behavior that can be observed broadly within the human population today. Vague suggestions centered around the concepts of evolution and brain intelligence mechanics do not even go to the heart of the matter—they specify nothing about the recent dynamics of human perceptual properties. Instead, the question to be asked is as follows: are there any observable characteristics, significantly present within the human population, that can account for a diminishment in the restrictive power of biological and conspecific perception, while at the same time introducing an expanded awareness for the underlying structural properties that humans now take advantage of in overwhelming abundance? The answer to this question is yes. There are such observable characteristics, and they have already been identified earlier in this essay. They are the same perceptual and behavioral characteristics that the Mottron team has outlined in exquisite detail in defining the distinctive nature of prototypical autism.

It remains unclear how and when the size of the autistic population became significant within the human species, but once that significance was reached, its impact would have been persistent and predictable. Not bound by the combined restrictive power of biological and conspecific perception, and driven by sensory need to an awareness of the structural features to be found in the surrounding environment, autistic individuals would have begun to bring these structural features to the perceptual fore, mostly through engagement in the so-called restricted and repetitive behaviors, behaviors that mirror and reconstruct the underlying structural properties autistic individuals naturally perceive. In turn, the non-autistic population, previously locked inside the restrictions of biological and conspecific perception, and yet keenly attuned to what other humans do, would have begun to notice these atypical autistic behaviors and the artificial constructions they engender, eventually adopting these behaviors and constructions for themselves.

This symbiotic process would have been slow and halting at first, but because it results in a permanent and artificial reconstruction of various aspects of the human environment, its impact becomes accretive. The increasing amount of artificial construction accruing within the environment gives autistic individuals an ever-growing array of perceptual targets to latch onto, and the survival-and-procreative efficacy of many of these artificial features—for instance, structured tools and weapons—gives non-autistic individuals an ever-growing incentive to adopt these atypical constructions for themselves. This symbiotic and accelerating process defines the historical pattern of the human behavioral turn, a pattern of increasing environmental reconstruction, built upon an increasing and autistically originated perceptual awareness of the environment's underlying structural properties.

This pattern continues unabated through the present day. It can be seen in the developmental course of non-autistic children, a course established first through the powerful and species-connecting consequence of conspecific perception, and furthered through a species-forward introduction into a broader world of artificial construction, a world valued precisely for the advantages it continues to bring to the species. And the pattern can be seen also in the ongoing discovery of previously unseen underlying structural attributes, a process notably and remarkably dominated by individuals possessing an abundance of autistic-like traits—Newton, Darwin, Einstein, Gauss, Dostoyevsky, Beethoven, Wittgenstein, Turing, to name just a few (James, 2003; Snyder, 2004). The human behavioral turn is still ongoing, and any search for its causal mechanism inside a genetic sequence or a neural signature would be nothing short of folly. Much easier would be to observe the process as it unfolds right before one's very eyes, unfolds in the symbiotic and productive relationship between the non-autistic and autistic types of perception.

5. Normal Autism Science

It was Thomas Kuhn who coined the phrase *normal science* to denote those stable periods of scientific practice during which revolutionary ideas are seldom considered or explored (Kuhn, 1962). As Kuhn describes it, the work of science during such periods tends to be more technical and incremental in nature, directed towards a shoring up and a promulgation of the prevailing paradigm. In Kuhn's world of the 1950s and 1960s, normal science was embodied in its textbooks, journals, conferences, academic associations, and so on, with these routine proceedings balanced to some extent by the fresh memories of recent upheavals, such as relativity and quantum mechanics. Thus, an equilibrium between normal science and scientific revolution seemed to have been established, and Kuhn was eloquently capturing its outline.

But what Kuhn failed to anticipate was that this particular form of normal science would soon grow into a cancer. Heavily influenced by the twentieth-century surge in governmental and commercial interests, the scientific community had been rapidly transforming from a relatively isolated domain of individuals into a mass operation gainfully employing many millions (Agar, 2012). And to keep this burgeoning crowd under paradigmatic control, science quickly transitioned into a system of professional and collaborative craft. Individuals stopped being individuals and became members of ever-enlarging teams. Scientific method morphed into countless codified standards of practice. Intricate networks of funding were established and soon became a primary and necessary goal. And credentials and citations began to form into a currency of status, the price of admission to the more elite corners of the field. Trampled in this march towards professional and collaborative craft was any interest directed towards individualistic and iconoclastic innovation, the kind of innovation that used to spawn scientific revolutions. By the beginning of the twenty-first century, for all intents and purposes, science had turned into nothing *but* normal science.

Nowhere is this circumstance more apparent than in the field of autism research. Having established early on a paradigm of autism as a dire medical condition, the autism research community has been leveraging this framework to grow by leaps and bounds (Jiang et al., 2023). The size and number of research teams, the catalogs of practice guidelines, university and government grants, citations and self-congratulatory awards—all have expanded exponentially over the last fifty plus years. And to keep this expansion under professional and collaborative control, autism projects and hypotheses are restricted to an acceptable domain: the search for the genetic markers of autism (Wiśniowiecka-Kowalnik & Nowakowska, 2019), the quest for the neural signatures of autism (Hernandez et al., 2015), the hunt for the metabolic insults of autism (Cheng et al., 2017), and of course the development of treatments and cures (DeFilippis & Wagner, 2016). Perhaps with just a few more research teams, perhaps with just one more set of practice guidelines, perhaps with the essential increase in government grant funding, or perhaps with some additional journal opportunities for self-citation, a breakthrough in an understanding of autism will appear around the corner just about any day. And so goes fifty plus years of normal autism science.

In the meantime, the plight of autistic individuals remains unchanged.

Misunderstood and mistreated, autistic individuals continue to be subjected to a broad range of corrective activities: applied behavioral analysis (Gitimoghaddam et al., 2022), depressive drug therapies (LeClerc & Easley, 2015), stem cell experimentation (Siniscalco et al., 2018), and so on—each treatment costing a pretty penny and each treatment designed to *suppress* autistic characteristics instead of making productive use of them. Normal autism scientists benefit greatly at the hands of normal autism science; autistic individuals suffer.

The Mottron team might be seen as pushing against the boundaries of normal autism science, and to a certain extent this characterization is valid. The Mottron team has been the one autism research team consistently arguing for the potential value of autistic characteristics, and the Mottron team has been the one autism research team willing to offer new theoretical approaches to the condition. But over the years, these efforts have amounted to little more than a chipping at the edges, a token stab at the idea of being revolutionary, with the team ultimately unwilling to venture far from modern science's career-protective walls. So when it comes to embracing a truly atypical conception of autism, and when it comes to considering and exploring autism's monumental impact upon the human species, the Mottron team maintains a comfortable silence. For autistic individuals, such reticence is a tragedy. Because for autistic individuals, of what value *is* a description of prototypical autism, if its primary purpose is to boost the statistical power of normal autism science?

References

Agar, J. (2012). *Science in the Twentieth Century and Beyond*. Cambridge: Polity.

Brignell, A., Chenausky, K. V., Song, H., Zhu, J., Suo, C., & Morgan, A. T. (2018). Communication interventions for autism spectrum disorder in minimally verbal children. *The Cochrane database of systematic reviews, 11*(11), CD012324. https://doi.org/10.1002/14651858.CD012324.pub2

Cheng, N., Rho, J. M., & Masino, S. A. (2017). Metabolic Dysfunction Underlying Autism Spectrum Disorder and Potential Treatment Approaches. *Frontiers in molecular neuroscience, 10*, 34. https://doi.org/10.3389/fnmol.2017.00034

Christian, D. (2018). *Origin story: a big history of everything.* First edition. New York, Little, Brown and Company.

DeFilippis, M., & Wagner, K. D. (2016). Treatment of Autism Spectrum Disorder in Children and Adolescents. *Psychopharmacology bulletin*, *46*(2), 18–41.

Gamlin C. (2017). When Asperger's Disorder Came Out. *Psychiatria Danubina*, *29*(Suppl 3), 214–218.

Gitimoghaddam, M., Chichkine, N., McArthur, L., Sangha, S. S., & Symington, V. (2022). Applied Behavior Analysis in Children and Youth with Autism Spectrum Disorders: A Scoping Review. *Perspectives on behavior science*, *45*(3), 521–557. https://doi.org/10.1007/s40614-022-00338-x

Hazen, E. P., Stornelli, J. L., O'Rourke, J. A., Koesterer, K., & McDougle, C. J. (2014). Sensory symptoms in autism spectrum disorders. *Harvard review of psychiatry*, *22*(2), 112–124. https://doi.org/10.1097/01.HRP.0000445143.08773.58

Hernandez, L. M., Rudie, J. D., Green, S. A., Bookheimer, S., & Dapretto, M. (2015). Neural signatures of autism spectrum disorders: insights into brain network dynamics. *Neuropsychopharmacology : official publication of the American College of Neuropsychopharmacology*, *40*(1), 171–189. https://doi.org/10.1038/npp.2014.172

Jacques, C., Courchesne, V., Meilleur, A.-A. S., Mineau, S., Ferguson, S., Cousineau, D., Labbe, A., Dawson, M., & Mottron, L. (2018). What interests young autistic children? An exploratory study of object exploration and repetitive behavior. *PLoS ONE, 13*(12), Article e0209251. https://doi.org/10.1371/journal.pone.0209251

James I. (2003). Singular scientists. *Journal of the Royal Society of Medicine*, *96*(1), 36–39. https://doi.org/10.1177/014107680309600112

Jiang, M., Lu, T., Yang, K., Li, X., Zhao, L., Zhang, D., Li, J., & Wang, L. (2023). Autism spectrum disorder research: knowledge mapping of progress and focus between 2011 and 2022. *Frontiers in psychiatry*, *14*, 1096769. https://doi.org/10.3389/fpsyt.2023.1096769

Kern, J. K., Trivedi, M. H., Garver, C. R., Grannemann, B. D., Andrews, A. A., Savla, J. S., Johnson, D. G., Mehta, J. A., & Schroeder, J. L. (2006). The pattern of sensory processing abnormalities in autism. *Autism : the international journal of research and practice*, *10*(5), 480–494. https://doi.org/10.1177/1362361306066564

Kéïta, L., Mottron, L., Dawson, M., & Bertone, A. (2011). Atypical lateral connectivity: a neural basis for altered visuospatial processing in autism. *Biological psychiatry*, *70*(9), 806–811. https://doi.org/10.1016/j.biopsych.2011.07.031

Klein, R. (2002). *The Dawn of Human Culture*. New York: Wiley.

Klein, R. G. (2009). *The human career: Human biological and cultural origins*. University of Chicago Press.

Kuhn, T. S. (1962). *The structure of scientific revolutions*. University of Chicago Press: Chicago.

LeClerc, S., & Easley, D. (2015). Pharmacological therapies for autism spectrum disorder: a review. *P & T : a peer-reviewed journal for formulary management*, *40*(6), 389–397.

Lickliter, R. (1991). Context and animal behavior: II. The role of conspecifics in species-typical perceptual development. *Ecological Psychology, 3*(1), 11–23. https://doi.org/10.1207/s15326969eco0301_1

Mottron, L., Dawson, M., Soulières, I., Hubert, B., & Burack, J. (2006). Enhanced perceptual functioning in autism: an update, and eight principles of autistic perception. *Journal of autism and developmental disorders*, *36*(1), 27–43. https://doi.org/10.1007/s10803-005-0040-7

Mottron, L., Belleville, S., Rouleau, G. A., & Collignon, O. (2014). Linking neocortical, cognitive, and genetic variability in autism with alterations of brain plasticity: the Trigger-Threshold-Target model. *Neuroscience and biobehavioral reviews*, *47*, 735–752. https://doi.org/10.1016/j.neubiorev.2014.07.012

Mottron, L. (2021a), A radical change in our autism research strategy is needed: Back to prototypes. *Autism Research, 14*: 2213-2220. https://doi.org/10.1002/aur.2494

Mottron L. (2021b). Progress in autism research requires several recognition-definition-investigation cycles. *Autism research : official journal of the International Society for Autism Research*, *14*(10), 2230–2234. https://doi.org/10.1002/aur.2524

Mottron, L., & Bzdok, D. (2022). Diagnosing as autistic people increasingly distant from prototypes lead neither to clinical benefit nor to the advancement of knowledge. *Molecular psychiatry*, *27*(2), 773–775. https://doi.org/10.1038/s41380-021-01343-3

Mottron, L., & Gagnon, D. (2023). Prototypical autism: New diagnostic criteria and asymmetrical bifurcation model. *Acta psychologica*, *237*, 103938. https://doi.org/10.1016/j.actpsy.2023.103938

Myers, S. M., Challman, T. D., Bernier, R., Bourgeron, T., Chung, W. K., Constantino, J. N., Eichler, E. E., Jacquemont, S., Miller, D. T., Mitchell, K. J., Zoghbi, H. Y., Martin, C. L., & Ledbetter, D. H. (2020). Insufficient Evidence for "Autism-Specific" Genes. *American journal of human genetics*, *106*(5), 587–595. https://doi.org/10.1016/j.ajhg.2020.04.004

Nunes, A. R., Carreira, L., Anbalagan, S., Blechman, J., Levkowitz, G., & Oliveira, R. F. (2020). Perceptual mechanisms of social affiliation in zebrafish. *Scientific reports*, *10*(1), 3642. https://doi.org/10.1038/s41598-020-60154-8

Parellada, M., Andreu-Bernabeu, Á., Burdeus, M., San José Cáceres, A., Urbiola, E., Carpenter, L. L., Kraguljac, N. V., McDonald, W. M., Nemeroff, C. B., Rodriguez, C. I., Widge, A. S., State, M. W., & Sanders, S. J. (2023). In Search of Biomarkers to Guide Interventions in Autism Spectrum Disorder: A Systematic Review. *The American journal of psychiatry*, *180*(1), 23–40. https://doi.org/10.1176/appi.ajp.21100992

Pinker, S. (1994). *The language instinct*. William Morrow & Co.

Poulin-Lord, M. P., Barbeau, E. B., Soulières, I., Monchi, O., Doyon, J., Benali, H., & Mottron, L. (2014). Increased topographical variability of task-related activation in perceptive and motor associative regions in adult autistics. *NeuroImage. Clinical*, *4*, 444–453. https://doi.org/10.1016/j.nicl.2014.02.008

Saalasti, S., Lepistö, T., Toppila, E., Kujala, T., Laakso, M., Nieminen-von Wendt, T., von Wendt, L., & Jansson-Verkasalo, E. (2008). Language abilities of children with Asperger syndrome. *Journal of autism and developmental disorders*, *38*(8), 1574–1580. https://doi.org/10.1007/s10803-008-0540-3

Sandbank, M., Bottema-Beutel, K., Crowley, S., Cassidy, M., Dunham, K., Feldman, J. I., Crank, J., Albarran, S. A., Raj, S., Mahbub, P., & Woynaroski, T. G. (2020). Project AIM: Autism intervention meta-analysis for studies of young children. *Psychological bulletin*, *146*(1), 1–29. https://doi.org/10.1037/bul0000215

Siniscalco, D., Kannan, S., Semprún-Hernández, N., Eshraghi, A. A., Brigida, A. L., & Antonucci, N. (2018). Stem cell therapy in autism: recent insights. *Stem cells and cloning : advances and applications*, *11*, 55–67. https://doi.org/10.2147/SCCAA.S155410

Snyder, A. (2004). Autistic genius?. *Nature 428*, 470–471. https://doi.org/10.1038/428470a

Soulières, I., Dawson, M., Samson, F., Barbeau, E. B., Sahyoun, C. P., Strangman, G. E., Zeffiro, T. A., & Mottron, L. (2009). Enhanced visual processing contributes to matrix reasoning in autism. *Human brain mapping*, *30*(12), 4082–4107. https://doi.org/10.1002/hbm.20831

Whitehouse, A., Varcin, K., Waddington, H., Sulek, R., Bent, C., Ashburner, J., Eapen, V., Goodall, E., Hudry, K., Roberts, J., Silove, N., Trembath, D. (2021). Interventions for children on the autism spectrum: A synthesis of research evidence. Autism CRC, Brisbane.

Wiśniowiecka-Kowalnik, B., & Nowakowska, B. A. (2019). Genetics and epigenetics of autism spectrum disorder-current evidence in the field. *Journal of applied genetics*, *60*(1), 37–47. https://doi.org/10.1007/s13353-018-00480-w

Ethics and Human Behavioral Modernity

Abstract

Humans were once purely animal, the same as all the other animal species, implying that the practice of ethics must have been nonexistent until quite recently in human history. It has been during the species' turn towards behavioral modernity that ethical precepts and systems have been formed, eventually becoming an integral part of modern human existence. This essay will explore the cause for this transition, emphasizing the idea that there are now two different sources of modern human behavior. On the one hand, modern humans are still animal, and they must still engage in biologically driven behaviors. At the same time, modern humans have become increasingly influenced and guided by the many artificial constructions that have been accruing over time and are now saturating the human landscape, with the response to these artificial constructions producing a wide range of behaviors heretofore unwitnessed on the planet Earth. These two aspects of modern humanity—the *animal* aspect and the *constructed* aspect—they find themselves often in conflict, each striving to gain ascendency over each individual and over the species as a whole. It is the tension at the heart of this inherent conflict that has engendered ethics and morality.

1. Introduction

It was Friedrich Nietzsche who highlighted that morality itself needs to be submitted to a critical scrutiny—his call for a revaluation of all values (Nietzsche, 2013). For such an endeavor, the fundamental question that must be addressed first is this: how did it come to be that there *is* such a thing as values? Why do human ethics exist at all?

It is not a theoretical question. In Nietzsche's day, the early biological history of humankind was still mostly unknown, and so to begin a genealogy of morals on the basis of ancient Greek and Hebrew culture, as Nietzsche did, must have seemed perfectly reasonable. But today, anthropologists possess a much fuller, and much longer, picture of the hominin timeline, and humans can trace their cultural and ethical sources to much earlier than classical civilizations (Quiros, 2012). Indeed, humans can trace their beginnings all the way back to when humans were not human in the modern sense of the word, when the species was still in fact purely animal (Klein, 2009). And since it is not generally considered a legitimate practice to apply ethical standards to wild animals, there must have been a time in human history when such standards could not have been applied to humans themselves, when there were no values to be valued—or to be revalued. Thus, the question needs to be asked again, non-theoretically: why do human ethics exist at all? What is it about the human transformation that has given birth to the practice of morality?

In attempting to explain the human turn towards behavioral modernity, scientists frequently resort to the notion of evolution—for instance, through such proposals as language genes and neural alterations (Klein, 2002; Pinker, 1994; Zwir et al., 2022). But these evolutionary explanations face serious challenges (Schlinger, 1996), including a lack of specificity and a need to fit a multitude of transformational events into an extremely narrow timeline. This essay will offer a more straightforward account of human behavioral modernity, outlining a depiction of modern humanity that can be directly observed today. This depiction underscores how humans have transitioned from once being purely animal to being *still* animal, but now with a significant and discernible addendum layered upon the entire species. This additional aspect of modern humanity can be denoted with the word *construct*, a word intended to consolidate the two indisputable categories of alteration that distinguish modern humans from their former purely animal selves:

1. The artificial reconstruction of the human environment; and,
2. The novel behaviors resulting from that artificial reconstruction.

Whereas humans were once animal and *only* animal, living in an entirely natural setting and displaying nothing but survival-and-procreative behaviors, humans today are both animal *and* construct, living in an environment that is more artificial than natural and displaying a mixture of behaviors that reflect both biological and synthetic roots. Therefore, modern humans and their activities are dual origined, a unique occurrence within the animal kingdom and a unique occurrence across evolutionary history.

Although this dual aspect of modern humanity has clearly had momentous impact, giving rise to the rich cultural tapestry currently experienced throughout twenty-first century civilization, it has also engendered an inevitable conflict, a conflict experienced by humans both interpersonally as well as internally. The two aspects of modern humanity, animal and construct, they are seldom in accord. The animal aspect of humanity is ancient in its origin, is grounded in immediacy, and gets its motivation from the self-serving needs of survival and procreation. The constructed aspect of humanity is extremely recent in its origin, requires delayed gratification, and receives its motivation from the desire for effective creation. The inherent conflict between these two aspects, distinctive to modern humans, is what gives birth to ethics and morality. Every ethical dilemma, at its core, comes down to the incompatibility between the animal and constructed sources of humankind, with each aspect striving to gain ascendency. Every moral quandary is ultimately a choice as to which influence is to be given the decisive sway, the beast within or the artificial structures all around.

This conflict has grown more intense over time and is now reaching a critical junction. The constructed aspect of humanity, once nonexistent, has continued to increase in both size and clout, and in many respects has become dominant over the species, including an authoritative claim upon morality itself. But as Nietzsche both recognized and railed against, an excessive suppression of humanity's animal nature brings unintended and unproductive consequences, including a loss of the vitality that has been spurring humanity onto its alternative course. Ultimately, for humans to continue to make progress on their unique biological path, they must find a way to reconcile and to transcend the inherent conflict between their two defining aspects, avoiding a return to complete animality and eschewing any acceptance of a complete artificiality.

2. Three Scenarios

First Scenario. A wild animal enters the territory of a mating pair of its own species. It surprises the male of the pair and attacks it, eventually killing it. The attacking animal then forces itself upon the female. It remains in the territory for the rest of the day and helps itself to the stashes of food the mating pair had gathered.

Second Scenario. A man breaks into a couple's apartment. He uses a baseball bat to stun and then kill the man of the couple. He then forces himself upon the woman. He lingers in the apartment for the remainder of the afternoon, eating the couple's food and eventually stealing the woman's jewelry.

Third Scenario. Around a half million years ago, before the beginning of the human turn towards behavioral modernity, a lone male hominin enters the territory of a hominin tribe. He surprises an isolated couple and uses a rock to stun and then kill the male. He then forces himself upon the female. He searches the outskirts of the territory and helps himself to any stashes of food he finds.

From a factual standpoint, these three scenarios appear to be almost entirely identical, and yet from an ethical standpoint, they seem to be considerably different. The second scenario crystallizes the ethics potentially at stake here, because its modern human setting removes any uncertainty as to whether an ethical standard can be applied. The intruder has committed murder, assault and robbery, three of the main classes of proscribed activity to be found in almost any modern ethical or criminal standard. Few people would attempt to justify the man's actions, and almost everyone would agree that if such activities were not regularly and severely punished, civilization as humans currently know it would soon be in danger of collapse. But if this second scenario is such a straightforward and obvious case of an ethical violation, why do the first and third scenarios seem more ambiguous? Is it simply the context of a modern human setting that makes the critical difference, and if this is so, what does this imply about ethics in general?

The first scenario contains no nuance—the event is immediately rewarding to the attacking animal and is no doubt a terrible experience for the victims. If there were ever a case in which an ethical precept could be applied to a wild animal, this instance would surely qualify. But that statement already betrays how easily humans can add an anthropocentric bias into the consideration of such matters. From the biological and evolutionary point of view, the attacking animal's activities are not only advantageous to itself and its genes but also might be advantageous to the entire species, possibly even essential (Gómez et al., 2021). If it were known that should certain members of the species not engage in such activities then the species would eventually weaken genetically and go extinct, would these activities still be judged as bad? Would they not instead be good? It can be reasonably argued that in nature, viability is the sole arbiter of what qualifies as "ethical," and at any rate, it never appears to be a matter of moral choice. In nature, what a wild animal *should* do is exactly what a wild animal is *driven* to do, and what a wild animal is driven to do is that which is most promising and satisfying in terms of increasing survival-and-procreative success.

So if ethical standards are not to be applied to the first scenario, a case of wild animals, and if ethical standards must be applied to the second scenario, a case of modern humans, then what is to be said about the third scenario, a case of humans just before they became modern humans? Many people today seem scarcely aware that humans were once—and not that long ago—purely animal, no different in nature and behavior than all the other wild animal species. But this fact is a critical input into understanding how humans have arrived at the circumstances they find themselves in today. Around a half million years ago, it would have made no more sense to apply an ethical standard to the interloping hominin than to apply that standard to the wild animal of the first scenario—indeed, the first and third scenarios could be different descriptions of the same event. Therefore, humans were not always an ethical creature. But this then raises the question of when did the transition take place, when did human activities become subject to ethical scrutiny? Was it around two hundred thousand years ago, when the features of behavioral modernity were still inchoate? Or was it around fifty thousand years ago, when the human turn had become more distinctive but still quite primitive? Or was it closer to ten thousand years ago, when agriculture and civilizations were on the verge of getting started? And was this transition sudden or gradual, and when did it apply effectively to the entire population? And finally, given this transitioning history, is it still reasonable to think that human ethical behavior can be attributed to human neurons and genes (Killen & Smetana, 2007)?

There are two further points to be gleaned from these three scenarios. First, the main classes of proscription to be found in modern ethical and criminal standards—for instance, murder, assault and robbery—they are clearly not arbitrarily chosen. They seem to be targeted exactly against the type of biologically self-advantageous behavior epitomized by the attacking animal of the first scenario. It is as though humans have come to realize that they have a compelling interest towards suppressing the beast within.

And second, to turn this motivation entirely around, modern humans also appear to have an inherent and nearly compulsive fascination with instances of raw ethical violation, such as outlined in the second scenario above (Binik, 2020). True crime podcasts, heist movies, rape fantasies, mob dramas on TV—there seems to be something fundamentally exciting and irresistible about the breaching of ethical laws. It is as though humans possess a deep-seated urge to unleash the beast within.

3. Modern Humans as Both Animal and Construct

Humanity's current circumstances are biologically unprecedented. Until now, every animal species has remained purely animal, with its behavioral characteristics fixed exclusively upon survival-and-procreative demand. In fact, so rigid and so predetermined have been animal behaviors across all species and across all time that they can be effectively summarized with nothing more than a simple phrase: *eating and drinking, fighting and fleeing,* *mating and rearing*. Hominins were like this too, for millions of years. But of late—and, evolutionarily speaking, over an extremely short period of time—humans have undergone a stunning transformation (Henshilwood & Marean, 2003). While retaining every animal characteristic with which they were originally endowed, humans have added an impressively broad range of behaviors heretofore unwitnessed and unexperienced upon the planet Earth—for instance, language, experimentation, art, and of course ethics.

The conventional explanation for the human transformation centers around the concept of evolution (Brown et al., 2011). For instance, maybe it was the emergence of a language gene or a significant neural alteration (Neubauer et al., 2018) that launched humans onto their more modern path. But these evolution-inspired explanations face some serious challenges. For one, they lack specificity. No identified language gene or detailed neural alteration has ever been put forth with any consistency or cogency, and even if they were put forth, no comprehensive or compelling description has ever been offered that would connect particular genes and neurons to actual human behaviors (Schaffner, 2016). The purveyors of such theories certainly have faith that such details will eventually be uncovered (Goetz & Shackelford, 2006), but they do not currently possess any direct evidence.

And perhaps even more troubling is the fact that evolutionary explanations of the human transformation must somehow be made to fit within an extremely narrow timeline. The beginning of the turn towards human behavioral modernity appears not to have taken place before more than a few hundred thousand years ago, and its initial impact must have been minimal for quite some time. By fifty thousand years ago, although the evidence of the human turn was now unmistakable—control of fire, structured tools and weapons, cave paintings, etc.—human behavior was still quite primitive, resembling hardly at all any of the modern forms of human experience (Christian, 2018). Indeed, the majority of the current behaviors arising from the human transformation—for instance, driving, flying, long-distance communication, effective surgeries, etc.—these all have appeared only within the last century or two, suggesting that the human behavioral transformation is still an ongoing and accelerating process. These rapid and accretive behavioral dynamics would be difficult to explain with just language genes and neural alterations—the dynamics do not fit to the usually slow-moving contours of a biological and evolutionary process.

Since there is little actual evidence to indicate that modern humans have undergone any kind of significant physical or biological change—including genetic or neurological change—it would seem a more effective approach to explaining the human transformation would be to concentrate on those human features that *have* changed. Since the beginning of the turn towards behavioral modernity, there have been two major categories of human transition for which there is now an overflowing abundance of observable evidence. The first category of indisputable human change is the amount of artificial construction that has been accruing within the human environment. Before the turn towards behavioral modernity, humans—just like all pure animals—lived within an entirely natural setting. But at the beginning of the transformation, several unusual artifacts started making a more or less permanent appearance within the human environment: structured tools and weapons, fire pits, animal skin clothing, ornamental jewelry, abstract gestures and sounds. And as the turn towards behavioral modernity progressed, the amount and types of these constructed artifacts continued to increase at an accelerating pace. Around ten thousand years ago, with the advent of agriculture and civilizations, humans experienced a massive surge in this reconstruction of their surrounding environment: houses, roads, ships, papyrus scrolls, gigantic monuments, etc. And around four hundred years ago, with the widespread introduction of scientific and industrial techniques, humans experienced yet one more leap in this rebuilding of their experienced world: trains, factories, skyscrapers, computers, and so much more. So pervasive has been the artificial reconstruction of the human environment that today nearly every human lives in a setting in which nature has been mostly, if not entirely, eclipsed from view.

The second category of indisputable human change is the enormous number of novel behaviors that have been engendered in direct response to this artificial reconstruction of the human environment. Every alteration to the human surroundings provokes a corresponding change in human behavior. Clothing alters where humans migrate and live (Gilligan, 2010), controlled fire alters what humans eat (Scott et al., 2016), structured weapons alter what humans hunt (Ben-Dor & Barkai, 2023), and so on.

And in the modern world, the catalog of human behaviors developed in direct response to the environment's many constructed artifacts has become so extensive and so all-encompassing as to be almost overlooked: humans drive because there are cars on the street, humans read because there are books on the shelf, humans shave because there are razors in the cabinet, etc. Human behavioral modernity did not arise within a vacuum, it arose instead in direct response to those many artificial constructions now saturating the human environment.

Nonetheless, and quite remarkably, in the midst of all this artificial reconstruction and its resulting behavioral novelty, humans have also retained the entirety of their former animal nature. Humans must still eat and drink, humans must still avoid danger, and humans must still procreate and rear their young. Humans have retained their communal instincts and still give evidence of their tendency towards gregariousness, with many of society's current activities and operations hearkening back to a more kindred time. Soap operas, org charts, crosstown sports rivalries—if one knows how to look carefully, one can still see the contours of a more tribal existence. And although humans are no longer raised to be self-sufficient hunter-gatherers within the natural surroundings of the African plains, humans still possess all the biological characteristics to do so. Humans carry with them today the same animal traits as they did several hundred thousand years ago.

Therefore, to characterize the human turn towards behavioral modernity, it is necessary to bridge the gap from humans as pure animal to humans as still animal but no longer purely so. A way to accomplish this feat would be to depict modern humans with the phrase *animal and construct*, a phrase meant to highlight the dual source of modern human behavior. The word *animal* of course needs no further justification. The word *construct* is being used to denote, as outlined above, the two categories of indisputable human change:

1. The artificial reconstruction of the human environment; and,
2. The novel behaviors resulting from that artificial reconstruction.

The word *construct* and its two-category meaning emphasizes how the newer aspects of humanity have been *built* into the species, forged tangibly into the human environment and fashioned perceptibly into human behavior. Thus, it is not really necessary to search for these new characteristics inside human neurons and genes, because these new characteristics can be observed directly right before one's very eyes. Furthermore, the word *construct* captures precisely the total amount of change that has been layered on to the species over the course of the human transformation, for if one were to remove every artificial feature that now exists within the human environment, and if one were to suppress every human behavior that can trace its origin back to those removed artifacts, all that would then remain would be the biological and evolutionary organism that once used to define *Homo sapiens*. All that would then remain would be the pure animal humans once used to be.

4. The Inherent Conflict

The dual-origined nature of modern humanity—animal on the one hand and construct on the other—gives rise to an inevitable tension. These two aspects differ greatly in their history, in their relationship with space and time, in their motivations, and in their ultimate goal. The animal aspect of humanity tends to pull the species backwards in time, towards the natural days of pure survival and procreation. The constructed aspect of humanity tends to push the species in a new direction, towards greater creation and towards a purpose that remains mostly unknown. This push-and-pull battle impacts the entire population and gives birth to ethical conflict, the species caught between the demands of its two competing interests. And this push-and-pull battle impacts each individual, now with the freedom of moral choice but also with no clear indication as to which influence is to be given the greater authority—the animal instincts within or the structured conditions all around.

It can be difficult to remember, amidst all the artificial construction humans find themselves immersed within today, that a person's most fundamental and deep-rooted nature is still that of a biological creature (Winston, 2003). And yet, humans are born, humans die, humans delight in their sexual congress, humans nurture their children towards adulthood, humans suffer through fear and pain, and humans experience every event of their entire existence in the immediacy of the here and now, just as was the case on the African plains several hundred thousand years ago. The most pressing of human needs are still those which are self-preserving, and the next most pressing of needs are those associated with family, betraying the continuing genetic favoritism of human evolutionary drive. Most humans still desire the comforts of close communal belonging, and many still cling to the security associated with tribal hierarchy. And although humans have learned they can suppress and assuage such needs and interests in favor of alternative goals, humans seldom do so with a feeling of unmitigated joy. Humans can sense instinctively that there is a *sacrifice* involved with taking the constructed path, the sacrifice of denying one's more natural wants and needs. The question is always lingering in the air: is the sacrificial benefit worth the cost? An observation of modern human behavior, in which the breaking of the rules is celebrated almost as frequently as the following of the rules (Morrall et al., 2018), would suggest the answer is still frequently no.

Therefore, the constructed aspect of humanity faces a daunting task. Having arisen from nothing and needing to build an expanding foothold onto the human scene, the constructed aspect of humanity must convince its subjects to forgo their immediate desires in favor of a promise for something better later on. Admittedly, artificial construction has frequently been able to deliver on this promise. From animal skin clothing and structured tools and weapons to the immense power of modern medicines and electricity, the built-up innovations of humankind have benefited the species to such an extent that there are now eight billion people living on the planet. But each new promise and each new construction requires a mastery of, and a patience with, time and space, a nod towards delayed gratification over more immediate alternatives. Not every human is willing to wait that long, and not every human foresees the personal benefit behind the promise. Human change is made in the face of a constant resistance, the resistance against doing what one is not naturally inclined to do.

It is to overcome this resistance that ethical precepts are formed. An ethical precept is much like other human-built artifacts—similar to language, to music, to agriculture, and to all the rest. But an ethical precept differs in this one important respect: it does not of itself serve any directly constructive purpose, it is instead *meta*-constructive, it makes room for other constructions to take place. An ethical precept accomplishes this task by confronting a stubborn obstacle, by cajoling, threatening, shaming, and otherwise convincing humans into giving up some aspect of their animal nature. A later reward over immediate pleasure. Civility as opposed to conquest. Cooperation instead of appropriation. Humanity's animal nature must be subdued in this manner because it is fundamentally opposed to humanity's more artificial alternative. Animal nature is often *de*structive instead of *con*structive. Animal nature is concerned only with the immediacy of the here and now, never with the expansiveness of time and space. Animal nature is motivated by the particular, the individual, the concrete, the familial, and remains oblivious to the abstract, the symmetrical, the numerical, the universal. Almost every concept upon which artificial construction can thrive is contravened by humanity's instincts, and thus there can be no human transformation without significant abeyance of this deep-seated bestial drive.

At the beginning of the turn towards behavioral modernity, humanity's animal aspect would have been dominant, with only a few sporadic instances of artificial construction to be found anywhere within the human surroundings, generating only the barest of need for any form of non-biological proscription. By around fifty thousand years ago, at the beginning of the last migration out of Africa, humanity's environment would have found itself more cluttered with newly developed artifacts—clothing, spears, hooks, jewelry, body painting, abstract gestures and sounds—with the impact of these artifacts nudging human activity onto alternative paths, creating a greater requirement for interactive structure and corporeal restraint, even if the balance at that time still stood in favor of the more primitive. By around ten thousand years ago, with the development of agriculture, permanent abodes, methods of transportation, and larger communities, the parity between animal and construct would have been shifting rapidly towards the latter, resulting in more multiplicity in human behavior and creating a burgeoning need to restrict instinctive conduct, leading to codified bodies of law, formalized means of enforcement, and more frequent entreaties towards habits of self-control.

Thus, as the human turn towards behavioral modernity has progressed, and as the amount of artificial construction within the human environment has continued to accrue, and as the influence of that construction upon human behavior has become more impactful, the need for ethical machinery has grown ever more intense. Ethical precepts have been combined into ethical systems, ethical systems have sought for justification (deity, rationality, utilitarian principles, etc.) (Griffiths, 1957), justification has brought stricter prosecution from the human surroundings. Reflecting the complexity of modern human circumstances, the ethical and moral systems of today are comprehensive, intricate, filled with nuance, and sometimes even contradictory (Francot, 2014), but at their core, all ethical systems still state the same basic tenet: humans must in some respect suppress the immediacy of their animal instincts in favor of more expansive, more distant, and more artificial goals. And at their perimeter, all ethical systems still encounter the same rudimentary defiance, the deep-seated human unwillingness to let go of the species' biological prerogative. Fundamentally, an ethical struggle is not a battle between good and bad, not a decision between right and wrong. Fundamentally, an ethical struggle is the expression of the inherent human conflict between animal and construct.

5. Consequences

Whereas the animal aspect of humanity would have been dominant at the beginning of the human turn towards behavioral modernity, today the circumstances have nearly reversed. Most humans today live in settings, such as large modern cities, in which nature has been almost entirely eclipsed from view, replaced everywhere by an assembled infrastructure that has become staggering in the degree of its depth and breadth (Guidotti, 2015). Human behavior, guided at every turn by the environment's many constructed artifacts, resembles hardly at all that of the other animal species, and resembles hardly at all that of hominins from a few hundred thousand years ago. Even the most elemental of human events—eating, drinking, sex, childbirth—these are accomplished today with the support of an entire host of artificial accoutrements—grocery stores, plumbing, contraception, anesthesia. And if modern humans find they must occasionally give vent to their animal essence, they can usually do so indirectly, through an assortment of vicarious, sublimated and assisted means—sports, beauty pageants, social media, pornography, alcohol, etc. Humans today expend as much effort *assuaging* the beast within as they do *expressing* the beast within; indeed, most people today fail to recognize that they are beasts at all.

Because of this near dominance of humanity's constructed aspect, and reflecting that aspect's ongoing effort to maintain a tight control over a large and potentially unruly animal population, ethics today is almost always presented as a one-sided argument. The conflict between animal and construct is framed as a battle of evil versus good, wrong opposed to right, devil contra savior, with these pronouncements backed by an assortment of doctrinal and rational justifications, such as the Decalogue, Kant's moral imperative, and utilitarian formulas. These days, to label someone as an animal is to effectively insult them, to describe someone as renegade is to attempt to shame them, and to cast someone as self-serving is to place them under the deepest of suspicion. Humans today expend as much effort *burying* the beast within as they do *expressing* the beast within; indeed, most people today refuse to admit that they are beasts at all.

Nietzsche's insight was to recognize the potentially debilitating impact of this stifling dynamic, arguing that the wholesale suppression of humanity's ingrained animal nature removes too much vitality from the quest towards human progress, and creates so much pent-up longing for zoic release that it manifests in unhealthy and unproductive ways. Despite their oppositional differences, humanity's animal and constructed aspects have managed to share a mutually supportive relationship, a relationship held together mainly by the species' biological impetus towards self-preservation and self-advantage. For instance, most of the constructed artifacts added over the years to the human surroundings have been targeted explicitly towards increasing the survival-and-procreative success of *Homo sapiens* and towards easing the more burdensome challenges of a biological existence. And it is the recognition and appreciation of these ecological benefits that motivates many humans to make the necessary sacrifices to give artificial construction an opportunity to grow, a motivation far more effective than any logical or theological justification. At the same time, it is often through an individual's desire for selfish gain that he or she will craft the next invention, formulate a novel idea, or build the newest towering structure (Weitzel et al., 2010). How many innovative projects have been launched by the egoistic actions of some person in search of greater power, wider fame and more lavish riches, and how many of these self-centered attempts have resulted in the advancement of circumstances for the population as a whole?

In humanity's better and more productive moments, there has always been a balance, a degree of equilibrium, between the animal and the constructed aspects of the species, with each aspect contributing its particular form of benefit to the cause of transformation. A complete dominance by either aspect would be of doubtful merit. For instance, a complete dominance by animality—such as might easily be experienced in civilization collapse—would mean at best a return to the species' former biological regimen, confining humans to the harsh and static realities of a survival-and-procreative existence, forgoing whatever unique opportunities and potential destiny behavioral modernity might have happened to bring. Similarly, a complete dominance by artificiality—conceivable these days with the advent of genetic engineering, robotics, artificial intelligence, and the like—would mean an absence of vitality in the shaping of future events, leading perhaps to an entirely fabricated existence, one that could easily turn out to be mechanical, predictable, stale, cold.

Foreshadowing these potential outcomes for the species as a whole are the consequences experienced today by the species' individual members, who find themselves confronted on an ongoing basis by these same animal-versus-construct choices. And for those individuals whose concerns reach no further than the contingencies of the present moment, and who seek no advantage beyond that which can be gained out of immediate circumstances, and who find their motivations only in what is self-serving and self-preserving, they run the danger of forging an existence that is narrow, calamitous, nasty, and Darwinian. And for those individuals whose concerns look only towards the promise of a distant future, and who seek no activity beyond that which can be described as righteously ascetic, and who have their motivations in the conformity underlying every widely proclaimed rule, they run the danger of forging an existence that is rigid, stagnant, joyless, and unnatural. The task of modern humanity is to traverse a precarious course between the two abysses of animal and construct, with the immediate goal to keep from falling to either side. The ultimate goal—the ultimate *human* goal—is to transcend the inherent conflict between the two.

References

Ben-Dor, Miki & Barkai, Ran. (2023). The Evolution of Paleolithic Hunting Weapons: A Response to Declining Prey Size. *Quaternary. 6*. 46. https://doi.org/10.3390/quat6030046

Binik, O. (2020). *The fascination with violence in contemporary society.* Springer International Publishing.

Brown, G. R., Dickins, T. E., Sear, R., & Laland, K. N. (2011). Evolutionary accounts of human behavioural diversity. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, *366*(1563), 313–324. https://doi.org/10.1098/rstb.2010.0267

Christian, D. (2018). *Origin story: a big history of everything.* First edition. New York, Little, Brown and Company.

Francot, L. M. A. (2014). Dealing with complexity, facing uncertainty: Morality and ethics in a complex society. *Archiv für Rechts- und Sozialphilosophie 100 (2)*:201-218. https://www.jstor.org/stable/24756800

Gilligan, I. (2010). The Prehistoric Development of Clothing: Archaeological Implications of a Thermal Model. *Journal of Archaeological Method and Theory*, *17*(1), 15-80. https://www.jstor.org/stable/25653129

Goetz, A. T., & Shackelford, T. K. (2006). Modern Application of Evolutionary Theory to Psychology: Key Concepts and Clarifications. *The American Journal of Psychology*, *119*(4), 567-584. https://doi.org/10.2307/20445364

Gómez, J.M., Verdú, M., & González-Megías, A. (2021). Killing conspecific adults in mammals. *Proceedings of the Royal Society B, 288*.

Griffiths, A. P. (1957). Justifying Moral Principles. *Proceedings of the Aristotelian Society*, *58*, 103-124. https://www.jstor.org/stable/4544591

Guidotti, T. L. (2015). Artificial Ecosystems, *Health and Sustainability: An Introduction* (New York, 2015; online edn, Oxford Academic, 23 Apr. 2015). https://doi.org/10.1093/acprof:oso/9780199325337.003.0009

Henshilwood, C. S., & Marean, C. W. (2003). The origin of modern human behavior. *Current anthropology*, *44*(5), 627–651. https://doi.org/10.1086/377665

Killen, M., & Smetana, J. (2007). The biology of morality: Human development and moral neuroscience [Editorial]. *Human Development, 50*(5), 241–243. https://doi.org/10.1159/000106413

Klein, R. (2002). *The Dawn of Human Culture*. New York: Wiley.

Klein, R. G. (2009). *The human career: Human biological and cultural origins*. University of Chicago Press.

Morrall P., Worton K., & Antony D. (2018). Why is murder fascinating and why does it matter to mental health professionals? *Mental Health Practice*. https://doi.org/10.7748/mhp.2018.e1249

Neubauer, S., Hublin, J. J., & Gunz, P. (2018). The evolution of modern human brain shape. *Science advances*, *4*(1), eaao5961. https://doi.org/10.1126/sciadv.aao5961

Nietzsche, F. (2013). *On the genealogy of morals* (R. C. Holub, Ed.; M. A. Scarpitti, Trans.). Penguin Classics.

Pinker, S. (1994). *The language instinct*. William Morrow & Co.

Quiros, F. (2012). The origin of ethics. *Human Evolution. 15.* 149-155. https://doi.org/10.1007/BF02436243

Schaffner, K. F. (2016). *Behaving: What's genetic, what's not, and why should we care?* Oxford University Press.

Schlinger, H.D. (1996) What's Wrong With Evolutionary Explanations of Human Behavior. *Behav. Soc. Iss. 6*, 35–54. https://doi.org/10.5210/bsi.v6i1.279

Scott, A. C., Chaloner, W. G., Belcher, C. M., & Roos, C. I. (2016). The interaction of fire and mankind: Introduction. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, *371*(1696), 20150162. https://doi.org/10.1098/rstb.2015.0162

Weitzel, U., Urbig, D., Desai, S., Sanders, M., & Acs, Z. (2010). The good, the bad, and the talented: Entrepreneurial talent and selfish behavior. *Journal of Economic Behavior & Organization, 76*(1), 64–81. https://doi.org/10.1016/j.jebo.2010.02.013

Winston, R. (2003). *Human instinct: How our primeval impulses shape our modern lives*. Bantam Press.

Zwir, I., Del-Val, C., Hintsanen, M., Cloninger, K. M., Romero-Zaliz, R., Mesa, A., Arnedo, J., Salas, R., Poblete, G. F., Raitoharju, E., Raitakari, O., Keltikangas-Järvinen, L., de Erausquin, G. A., Tattersall, I., Lehtimäki, T., & Cloninger, C. R. (2022). Evolution of genetic networks for human creativity. *Molecular psychiatry*, *27*(1), 354–376. https://doi.org/10.1038/s41380-021-01097-y

Theology, Philosophy, Science, and Big History

Abstract

Although Big History has been producing growing impact upon the academic and learning communities, its ideas have yet to penetrate deeply into the broader mindset. One of the reasons for this is that there is bound to be some natural resistance to Big History, since Big History challenges the manner in which humans have traditionally regarded themselves, including their anthropocentric bias towards the notion of an inherent human eminence. This bias permeates nearly every branch of human study, including theology, philosophy and science, and can be seen for instance in the way that humans have crafted humanlike gods and have once seen fit to place Earth at the center of their universe. Although Big History recognizes and promotes the specialness of the human species, Big History paradoxically does so in a manner which challenges the idea of an inherent human eminence. Therefore, Big History will have a wider impact when its concepts begin to infiltrate and to alter the more traditional forms of human study, giving them the opportunity to be seen afresh from the broad perspective that Big History brings.

1. Introduction

The academic discipline known as Big History has been gaining in popularity and reach. Originated by David Christian in 1989 (Christian,

1991) and based upon cosmological, evolutionary and anthropological evidence that has been crystallized only as recently as the mid-twentieth century, Big History today is reaching its widening audience through an assortment of propagative means: best-selling books, online learning portals, high school and university classrooms, etc. There is some reason to expect that the influence of Big History might one day equal or even surpass that of the more traditional history curriculum (Popp, 2023).

Big History delineates itself by encompassing the entire temporal range of the known universe, beginning with the Big Bang around 13.8 billion years ago, then working through the long formation of the stars, galaxies and chemical elements, passing next to the emergence of biological life upon the planet Earth beginning around 3.8 billion years ago—including the protracted dominance of single-celled life, followed by the more recent advent of multicellular big life—and finally focusing on the arrival of hominins and their surprising and unique transformation from a few hundred thousand bestial hunter-gatherers to the eight billion current denizens of an intricately constructed modern civilization. This wide perspective demonstrates one of Big History's main objectives, to provide the broadest and most evidence-based context possible for the ongoing study of humans and their surrounding world (Christian, 2017).

Although Big History has been having a growing impact upon the academic and learning communities, its concepts have yet to penetrate deeply into the broader mindset. Part of the reason for this is of course that the discipline is relatively new, but there is also cause to expect that there will be a natural resistance to the ideas that Big History brings. This resistance stems from the manner in which humans have traditionally regarded themselves and their place within their surrounding world. As they have progressed towards behavioral modernity and have experienced a growing need to explain themselves, humans have almost always given preference to the notion of human eminence—that is, to the idea that the universe has endowed humanity with advanced attributes and a favored status, thereby accounting for the species' unique and extraordinary abilities. This anthropocentric approach to self-explication permeates nearly every traditional form of human study, including theology, philosophy, and even science itself, meaning that the concept of human specialness has become so deeply ingrained within the zeitgeist that it is embraced almost without reflection. Nonetheless, this anthropocentric approach to explaining humanity has usually betrayed itself as a form of magical thinking—for instance, when humans saw fit to place themselves at the center of their universe. Much like this attempt, nearly every other attempt to explain the human species through an appeal to inherent human eminence has foundered against the facts of a sober reality.

What Big History can provide is a paradoxical opportunity for humans to reconsider this type of magical thinking and to begin to reassess themselves from a new perspective. This opportunity is paradoxical because at first glance it would appear that Big History, with its enormous temporal-spatial range and its recognition of the tremendous and long-running variety of Earth's biological abundance, must necessarily overwhelm any notion of human specialness. But in fact, this is not the case at all (Spier, 2010). Big History actually *promotes* the idea of human specialness, devoting a large portion of its focus to the many astounding facets of the recent human transformation, while at the same time providing a broad enough context to make clear just how unique and consequential the human species is. The irony of Big History is that it does indeed recognize human specialness, but just not for the reasons humans have traditionally held. Therefore, Big History will have its most significant impact when it begins to infiltrate the more traditional forms of human study, such as theology, philosophy and science. These traditional forms of human study must be seen afresh in the light of Big History's broad perspective, and must be given the opportunity to start anew.

2. The Paradox of Big History and Humanity

Humanity's role within Big History is paradoxical. On the one hand, given the backdrop of 13.8 billion years of chemical and galactic formation, and given the further context of nearly four billion years of biological and evolutionary life upon the planet Earth, humanity's trace upon Big History's spatial-temporal domain would appear to be nothing more than an insignificant blip. Hominins have been in existence for only 0.05% of the universe's timeline, and *Homo sapiens* has been around for a mere 0.0015% of that timeline (Christian, 2004). Plus the geographical reach of humankind, even including the entirety of the Earth's surface and the occasional trip to the moon, is still so infinitesimally small within the expanse of the cosmos as to be essentially irrelevant. The notion that humans are somehow a special creature within this world seems at first to be the height of ridiculousness, a feeble and anthropocentric attempt to elevate the species from pure paltriness to the epitome of grandeur. The size and scope of Big History must be laughing in the face of that attempt.

And yet….

In the standard depiction of Big History's eight transitional thresholds, no less than three of these thresholds are devoted to just one entity—and in fact, that entity is the human species. And of all the transformational stories that Big History has the ability to unfold, none is more multifaceted and unexpected than the sudden human metamorphosis from bestial hunter-gatherer to the constantly talking, constantly innovating, constantly constructing organism that modern humans have become (Frank, 2005). All the telltale signs of a momentous event are present within the human story: an ever-increasing and more focused use of energy, a leveraging of goldilocks effects, and a quantum leap in complexity that defies entropy's relentless tug. Furthermore, the pace of this human transition has been nothing short of stunning, on a scale of only several thousands or even hundreds of years, in the sharpest contrast to Big History's more typical millions-and-billions-of-years meandering course. Finally, within this neighborhood of the known universe, awareness of Big History itself is entirely dependent upon the human species. Not in the solar systems and galaxies, not in the chemical elements and their multitude of combinations, and not in the countless other species forming the broad array of Earth's biological abundance, not anywhere else within an observable radius is there even the slightest hint of an awareness of the size and depth of the universe, of an awareness of any aspect of Big History's tremendous range. It is through humanity, and through humanity alone, that the universe can reflect back upon itself, an occasion that is surely not an insignificant blip.

The marvel in this paradox of Big History and humanity is how it mirrors the paradox of the way humans have traditionally regarded themselves. As they have marched towards behavioral modernity, humans have always explained their expanding presence within their expanding world by appealing to their own eminent nature. This is reflected in theology, where the gods are adorned with humanlike attributes, and in turn humans are crafted in the perfect image of their gods (Peterson, 2016). This is reflected in philosophy, where humans are portrayed as mastering their experience through an abundance of unique and intrinsic characteristics—language, rationality, moral sensibility, etc. (Ramsey, 2023). This is reflected in the natural sciences, where Earth, the human home, is placed at the center of a revolving and subservient universe (Americo, 2017). Yes, as they have marched towards behavioral modernity, humans have always explained their expanding presence within their expanding world by appealing to their own eminent nature—and humans have always been wrong. Earth is not located at the center of the universe. Humans were once—and not that long ago—purely animal, without the slightest evidence of language, rationality, or moral sensibility. And in a cosmos infinitely larger than the human domain, and in a timeline infinitely longer than the human epoch, any suggestion that the gods exist specifically for humans and for humans alone betrays itself as nothing more than a human fancy. Every attempt to explain humanity through an appeal to inherent human eminence has foundered against the facts of a sober reality.

And yet….

Although there has certainly been errancy in the details, the persistent conviction that there is something extraordinary about the human species must clearly be true. Consider that there is no other object and no other creature in the known universe that has ever even conceived of a god—what a glorious innovation. Consider that there is no other object and no other creature in the known universe that has inventoried its own unique qualities and made practice to exalt and to strengthen those qualities—what an intelligent thing to do. Consider that there is no other object and no other creature in the known universe that has noticed the patterns in the surrounding skies and made model of that celestial course—it is a construction most marvelous. The *errors* of humanity, the errors alone, they are enough to set the species apart from every other known entity in the surrounding universe. The irony in humanity's many faulty attempts to explain itself as something special is that these attempts alone have proven the thesis to be fundamentally accurate. Humans are indeed extraordinary—extraordinary to an infinite degree—just not for the reasons humans have traditionally held.

3. Theology

Animals do not contemplate gods, and so neither did humans for a very long time. The human turn away from a purely animal nature and towards the characteristics of human behavioral modernity appears not to have started until around a few hundred thousand years ago (Henshilwood & Marean, 2003) and would have progressed slowly until around fifty thousand years ago (Klein, 2002)—at the time of the latest out-of-Africa migration—and did not begin to really accelerate until the rise of agriculture and civilizations, beginning around ten thousand years ago (Christian, 2018). This gradual awakening to an awareness of themselves and of their surrounding world, including an expanding conception of space and time, would have given humans a sense of wonder about how these circumstances had come to be and what events the future might possibly hold. Given the limited state of knowledge in those early days, the attempt to embody and to personify unknown causal forces in the form of a concerned and efficacious entity would have been nothing short of a stroke of genius. Those today who would ridicule religious thinking as somehow irrational are simply ignoring the history—in emerging from a purely animal past, for humans to have conceived of such a thing as a powerful and constructive deity to explain their many dawning discoveries would have been an innovative and generative act.

The history of religion further reveals that as humans have gained more knowledge and more understanding about their circumstances, their theologies have tended to adjust accordingly, becoming increasingly sophisticated with time (Peoples et al., 2016). Some of the earliest gods were simply equated to natural features and events—the river god, the sun god, the thunder god, etc. But requiring deeper answers to newer and more complex questions, humans began to contemplate gods of a richer character, turning for inspiration to the obvious and natural example of humans themselves. Beginning with the lusts, jealousies and conflicts of the ancient classical gods, the cladding of deities and angels with humanlike attributes would reach its culmination in the three major Western religions that are still practiced widely today—Judaism, Christianity and Islam. Covenants, law giving, personal conversation, incarnation. Even today, almost no child grows up in the Western world without an early conception of God as something like a wise and venerable man, bearded and perhaps a little bald, more humanlike than most humans themselves (Nyhof & Johnson, 2017). In turn, these human-inspired deities have been solicitous for their subjects, first and foremost at the moment of creation—crafting human beings simultaneously alongside a supportive world—and also in the moments of need and upheaval—through revelation, through resurrection, through the destruction of enemy forces.

In the twenty-first century, it is easy to forget that until as recently as a few hundred years ago, the assumed age of the earth was only a handful of thousands of years, and the physical extent of the universe, centered around the human home, was thought to be quite compact, with each sky-bound object near enough to be welcomed into the celestial neighborhood (Grant, 1997). With such notions of temporal immediacy and spatial locality, the concept of a personal and intervening god would have been perfectly plausible, indeed almost essential. It is only through the litany of recent cosmological, evolutionary and anthropological discoveries, now gathered within the folds of Big History—for instance, that the universe is actually billions of years old, that life had existed upon Earth long before humans came to be, that humans were once animals just like all the other animals, and that during their transformation to behavioral modernity, humans literally constructed every aspect of their modern world, including the deities—it is only through this litany of recent cosmological, evolutionary and anthropological discoveries that the assumptions upon which every current theology has been built have now been thoroughly destroyed. Big History has been a sledgehammer to the foundations of human theology.

Nonetheless, Big History also provides an opportunity for theology, the opportunity to adjust, as past theologies always have. The need to encapsulate the still unexplained features of human existence has not entirely disappeared, and although some will choose simply to live with the uncertainty, others will find greater benefit in the concept of an all-encompassing understanding, one that humans have yet to acquire and to achieve. Therefore, there is still room for a twenty-first century theology, as long as that theology can take the brave and constructive step of discarding old assumptions and incorporating new information. For instance, what type of theology will assimilate 13.8 billion years of time and a nearly infinite expanse of space, and not obsess with the human here and now? What type of theology will contemplate nearly four billion years of evolutionary life upon the planet Earth, as well as the likelihood of similar biological existences all around the universe, none less deserving of divine attention than the organisms of the present home? What type of theology will be humble enough to accept that humans were once—and not that long ago—purely animal, and that humans still retain all of those animal characteristics today? What type of theology will acknowledge that it has been humans alone who have constructed the entirety of the artificial modern world—without supernatural intervention, without superhuman miracle—and what type of theology will acquiesce to counting among those many artificial constructions the religions themselves?

The type of magical thinking that Big History exposes is the idea of an inherent human eminence. In theology, that type of magical thinking is most directly expressed in the notion of a personal, concerned, intervening, and humanlike god. It is a notion that was conceived naturally and wisely, it is a notion that now forms the cornerstone of every major Western religion, and it is a notion for which it will be extremely difficult to let go. But it is a notion that is no longer tenable within the context of Big History. Any twenty-first century theology not directly addressing and assimilating the facts of Big History (Ottati, 2020) is a theology simply begging to be ignored.

4. Philosophy

The origins of theology and philosophy would be difficult to separate, since each arose out of the need to answer similar questions, questions about the nature of humanity and its status within a widening world (Durfee, 1952). But whereas theology found its focus in the contemplation of external influences shaping the human experience, philosophy—at least the part not concerned with the natural sciences—found its footing in the contemplation of the human qualities, particularly those qualities clearly distinguishing humans from the remainder of the animal kingdom. Humans as the *rational* animal. Humans as the *languaged* animal. Humans as the *moral* animal. Philosophy's great achievement then arose out of the follow-up to the recognition of these unique human qualities, with philosophy taking on the task of strengthening and promoting those qualities, urging humans towards a greater perfection through the process of becoming still more human. Philosophical thought has always seemed to recognize instinctively that humans are not the *stagnant* animal, that unlike the other animal species, there is something fundamentally mutative underlying *Homo sapiens*.

Philosophy's mistake has been not to follow this awareness of human mutation all the way back to its initial source. In philosophy, the distinctive human qualities have always been taken as a given, as attributes that have been *intrinsic* to humanity from the beginning, instead of attributes that have been *transforming* humanity over time. For some philosophers, the presumption has been that these qualities have been bestowed by a benevolent god, and for others it would seem these qualities have just spontaneously appeared, but either way, the entirety of the Western philosophical canon—from Plato's cave to Descartes' cogito to Kant's moral imperative—has been built upon the assumption that humans inherently are, and have always been, rational, languaged, moral, etc., that humans carry these qualities within them, as mind, soul, spirit, consciousness, or call it what you will. For philosophy, these intrinsic qualities are what establish the separation from and the superiority over the plant and animal kingdoms—establish inherent human eminence—giving the species a kind of natural and preordained status as the paramount organism of the biological world (Ruse, 2021).

Big History puts the lie to this form of magical thinking. The preamble to modern human existence covers an extremely long period of time, including three billion years of exclusively single-celled life, then several hundred million years of multicellular big life before the appearance of primates, and then about seven million years of hominins themselves. At no moment in this tremendous range of evolutionary time, and in no creature throughout the enormity of Earth's biological abundance, has there ever been even the slightest hint of anything resembling rationality, language, or morality. For the entire biological world, including hominins until quite recently, life was strictly a survival-and-procreative venture, dominated entirely by the evolutionary demands of the here and now. Until just a few hundred thousand years ago, the idea that humans were a preordained and preeminent creature within the biological world would have been observably ludicrous. Humans, for millions of years, were no more than an animal, no different in their essential nature than all the other animals. And just as importantly, humans are still animals today (Sartwell, 2021).

Although by evolutionary standards the transition to human behavioral modernity has been extraordinarily rapid, it has not been instantaneous (Kissel & Fuentes, 2018). There is no evidence that a god one day nodded its head and turned humans into an intelligent, talkative and ethical race, and there is also no indication that humans one day happened to wake up and find themselves cogent, loquacious and virtuous. The last three thresholds of Big History, focused entirely on the human species, outline a continuous and accelerating transformation, from a pure beast living in a completely natural setting and concerned only with survival and procreation, to a modern organism situated firmly inside an artificially constructed environment and displaying increasingly complex behaviors in response to that artificial construction. The *facts* of Big History give no evidence of there having been inherent human qualities such as rationality, language or morality. What the *facts* of Big History point to is an ongoing, accumulating and palpable reconstruction of the human environment: fire pits, structured tools and weapons, ornamental jewelry, irrigation trenches, pottery wheels, thatched abodes, rafts, carts, stone monuments, etched symbols, printing presses, telescopes, steam engines, automobiles, rocket ships, skyscrapers, computers. What the *facts* of Big History describe are a species continually altering and expanding its behaviors in direct response to those artificial reconstructions—for instance, by *navigating* and *manipulating* their increasingly artificial world, and thereby displaying increasing levels of intelligence; for instance, by *representing* their increasingly artificial world, and thereby showcasing an expanding use of language; for instance, by *negotiating* and *sharing* their increasingly artificial world, and thereby developing a broadening practice of ethics. What the *facts* of Big History make clear is that humans have become special not for what they *inherently are* but instead for what they have *constructively done*. Rationality, language, morality—just like with the religions—these are simply human constructions. They are *self*-constructions, and there has been nothing magical about the building process, a process that has been both accretive and observable, and is still ongoing, existing right there in front of everyone's eyes.

For today's philosophers—too many of whom are unfortunately to be found comfortably and blindly ensconced inside academic walls (Kallens et al., 2022)—Big History should be the spur to a massive reconsideration of their entire subject of study. Although it might not be necessary to throw out the entirety of the Western philosophical canon, nearly every word should be reconsidered with fresher eyes, reconsidered in the light of how humans have come to acquire their rationality, their language, their morality, and how that acquisition remains ongoing today. Gone should be magical words such as *mind* and *soul*, and in their stead should be given greater attention to the observable mutations taking place within the human environment, and greater attention to the impact those mutations have upon human behavior. Big History provides the necessary perspective upon which to make these observations of continuous human change, and therefore any twenty-first century philosophy not directly addressing and assimilating the facts of Big History (Grayling, 2005) is a philosophy of dubious intellectual merit.

5. Science

In most respects, science forms the backbone of Big History, providing the litany of sober, observable and testable facts that have constituted Big History's timeline and all-encompassing descriptions (Chaisson, 2014). But it has not always been that way with the natural sciences. Like nearly every other target of human curiosity, the physical world was first approached with an anthropocentric bias, leading to such theories as the geocentric universe and a chemistry composed out of the substances most prominent to the human senses, such as fire, water, earth and air. The revolution that began with the empirical awakening of around four hundred years ago—coinciding with Big History's most recent transitional threshold—was effective precisely because it removed the human perspective from the equation, removed the viewpoint of human eminence. Employing the tools of mathematics and experimentation, humans began witnessing their world through an unbiased set of eyes, and the results were immediately astounding, propelling the human transformative process into extreme overdrive (Cohen, 1994). The laws of motion. The laws of gravity. Atomic and molecular theory. Electricity and magnetism. Evolution. Genetics. Relativity. Quantum mechanics. People today swim in such a deep ocean of artifacts and understandings derived from these many recent discoveries that they must find it almost impossible to realize that none of these artifacts and understandings existed only a handful of generations ago. The culmination of these unbiased scientific efforts is the combined cosmological, evolutionary and anthropological understanding that coalesced around the middle of the twentieth century and became the material of Big History, an occurrence of the universe reflecting back upon itself. Big History stands as a crowning jewel of science.

Nonetheless, old habits have a tendency to linger. Ironically, the one topic in the natural world that still remains poorly understood is the topic of humans themselves. Although more is now known about the historical and biological buildup to *Homo sapiens*, and although new facts continue to be uncovered every day regarding the stages of the human transformation to behavioral modernity, the proposed explanations for this unique transformation have remained entirely inadequate, and seem also to reek from the stench of human eminence. This can be seen in the many dubious attempts to employ evolution as the explanatory cause for the human transformation, whether these attempts are based upon biology (Zwir et al., 2022), culture (Stanford, 2020), or psychological musings (Jonason, 2017). Ask yourself, what type of thinking would take a process that is known to happen genetically, randomly, piecemeal and mostly gradually over the course of hundreds of millions of years, and then apply that process to a transformation that has been accelerating population wide over but a sliver of that time, and with an overwhelming multitude of observably new effects—intelligence, language, mathematics, logic, innovation, construction, ethics, and so on. Scientifically speaking, evolution would seem to be the *worst* possible explanation for the human transformation, but today's scientists—human scientists—cannot seem to help themselves. Their species is special after all, is it not, so why not make a scientific exception, and explain the human transformation as evolution run amok.

Or take the prevailing neurological hypothesis regarding the human transformation, the notion of a superior human brain. What a marvel of biological engineering that organ must be, with its nodes and modules primed for language, with its nodes and modules designed for computation, with its nodes and modules tuned for logic, with its nodes and modules targeting advanced social activity, with its nodes and modules accounting for almost every unique human behavior to be found under the current sun. Then develop an impressive-sounding phrenology based upon an assortment of colorful neuroimaging photographs, and apparently no further explanation is required (Jung & Haier, 2007). Never mind that not a single evidentiary detail has ever been provided describing how all this biological wiring is supposed to work (Uttal, 2001). Never mind that there has never been a cogent indication of how this incredibly complex apparatus suddenly came into existence, leaving not a single hominin behind. Never mind that a billions-of-years-old biological system designed solely as a stimulus/response mechanism has now been modified within just this one species to take on a wide variety of additional roles. Never mind all this, say today's neuroscientists—human neuroscientists—because their species is special after all, is it not, and that certainly justifies a neurological exception, justifies explaining the human transformation as the by-product of a preeminent human brain.

It should be noted as well that the study of Big History itself is not immune to this type of anthropocentric thinking. The most frequent explanation provided by Big History academicians to account for the human transformation is that it is the outcome of *collective learning*, the accumulative passing along of information from generation to generation, in the form of stories, rituals, art, song, instruction, and so on (Baker, 2015). But then what exactly is explaining what? If collective learning is composed out of stories, rituals, art, song, instruction, and so on, then is it not itself entirely dependent upon language, intelligence, social cooperation, etc.? Does collective learning explain the human transformation, or is it collective learning itself that needs to be explained? Never mind the confusion, say Big History's academicians—human academicians—because this is the beloved human species after all, is it not, with its cherished stories, rituals, art, song, instruction, and so on, so why be troubled by a little case of circular reasoning?

Implausibly rapid evolution, impossibly sophisticated neurology, illogically circular collective learning—these are no less forms of magical thinking than the idea it was a god who created modern humanity, or that modern humanity just spontaneously appeared. The lesson from science is that one must focus solely on the describable facts, and not insert additional perspectives, because these perspectives are almost certainly bound to be biased. It was only when the notion of human eminence was *removed* from scientific thinking that science began to flourish, and it is only when the notion of human eminence is *reinserted* into scientific thinking that science begins to flounder. Today's scientists must remember these hard-earned lessons, because any twenty-first century science not maintaining its objectivity, and not addressing and assimilating only the *facts* of Big History, is a science gone off the rails.

6. The Sober Reality of Big History

Big History provides humanity with an opportunity. To date, humans have been in the habit of regarding themselves as a special entity within the universe, almost to the point of giddiness, willing to accept nearly any magical explanation that would support the notion of an inherent human eminence. This attitude has certainly been understandable, given humanity's surprising and fast emergence from its animal past and given humanity's unique and expanding awareness of space and time. But this attitude has also been blinding, keeping humans from a more sober reflection upon their unusual circumstances and upon how those circumstances have come to be. Big History, when done well, provides the broad context for this type of needed sober reflection, and it also provides an antidote to magical thinking.

The ironic consequence of embracing Big History is that by dispensing with the notion of an inherent human eminence, humans can then gain insight into what has actually made the species special. Not the hand of a god. Not intrinsic spontaneous qualities. Not scientific voodoo. What has made humans special is not what they inherently are but instead what they have constructively done, literally building themselves into the modern organisms they are today. The last three thresholds of Big History chart this course of artificial environmental reconstruction, and these three thresholds also make clear that humanity does not possess a predetermined or accomplished fate. The reconstruction of the human environment and its altering impact upon human behavior remains ongoing, indeed still seems to be accelerating, with the future remaining entirely full of possibility.

References

Americo, M. (2017). A Brief History of Premodern Astronomical Models. *The Classical Outlook*, *92*(3), 94–101. https://www.jstor.org/stable/26431167

Baker, D. (2015). Collective Learning: A Potential Unifying Theme of Human History. *Journal of World History*, *26*(1), 77–104. http://www.jstor.org/stable/43818826

Chaisson E. J. (2014). The natural science underlying big history. *TheScientificWorldJournal*, *2014*, 384912. https://doi.org/10.1155/2014/384912

Christian, D. (1991). The case for 'Big History'. *Journal of World History*, *2*(2), 223-238. http://www.jstor.org/stable/20078501

Christian, D. (2004). *Maps of Time: An Introduction to Big History* (1st ed.). University of California Press. https://www.jstor.org/stable/10.1525/j.ctt1pnwzw

Christian, D. (2017). What is Big History?. *Journal of Big History.* https://doi.org/10.22339/jbh.v1i1.2241

Christian, D. (2018). *Origin story: a big history of everything.* First edition. New York, Little, Brown and Company.

Cohen, H. (1994). *The Scientific Revolution: A Historiographical Inquiry*. University of Chicago.

Durfee, H. A. (1952). The Relationship of Philosophy, Theology, and Religion. *The Journal of Religion*, *32*(3), 188–197. http://www.jstor.org/stable/1201167

Frank, A.G. (2005). Universal History: Sizing Up Humanity in Big History. *Journal of World History 16*(1), 83-97. https://doi.org/10.1353/jwh.2005.0136

Grant, E. (1997). The Medieval Cosmos: Its Structure and Operation. *Journal for the History of Astronomy*, *28*(2), 147-167. https://doi.org/10.1177/002182869702800206

Grayling, A. C. (2005). *The heart of things: applying philosophy to the 21[st] century*. London: Weidenfeld & Nicolson.

Henshilwood, C. S., & Marean, C. W. (2003). The Origin of Modern Human Behavior: Critique of the Models and Their Test Implications. *Current Anthropology*, *44*(5), 627–651. https://doi.org/10.1086/377665

Jonason P. K. (2017). The Grand Challenges for Evolutionary Psychology: Survival Challenges for a Discipline. *Frontiers in psychology*, *8*, 1727. https://doi.org/10.3389/fpsyg.2017.01727

Jung, R. E., & Haier, R. J. (2007). The Parieto-Frontal Integration Theory (P-FIT) of intelligence: converging neuroimaging evidence. *The Behavioral and brain sciences*, *30*(2), 135–187. https://doi.org/10.1017/S0140525X07001185

Kallens, P. C., Hicks, D. J. & Jennings, C. D. (2022). Networks in philosophy: Social networks and employment in academic philosophy. *Metaphilosophy 53* (5):653-684.

Kissel, M., & Fuentes, A. (2018). 'Behavioral modernity' as a process, not an event, in the human niche. *Time and Mind*, *11*(2), 163–183. https://doi.org/10.1080/1751696X.2018.1469230

Klein, R. (2002). *The Dawn of Human Culture*. New York: Wiley.

Nyhof, M. A., & Johnson, C. N. (2017). Is God just a big person? Children's conceptions of God across cultures and religious traditions. *The British journal of developmental psychology*, *35*(1), 60–75. https://doi.org/10.1111/bjdp.12173

Ottati, D. (2020). *A Theology for the Twenty-First Century*. Grand Rapids: William B. Eerdmans Publishing Company.

Peoples, H. C., Duda, P., & Marlowe, F. W. (2016). Hunter-Gatherers and the Origins of Religion. *Human nature (Hawthorne, N.Y.)*, *27*(3), 261–282. https://doi.org/10.1007/s12110-016-9260-0

Peterson, R. S. (2016). *The Imago Dei as Human Identity: A Theological Interpretation* (Vol. 14). Penn State University Press. https://doi.org/10.5325/j.ctv1bxh0jj

Popp, S. (2023). World History, Global History, Big History: Some remarks on terminology and concepts in relation to history curricula and textbooks. *Hungarian Educational Research Journal*, *13*(4), 470-485. https://doi.org/10.1556/063.2023.00160

Ramsey, G. (2023). *Human Nature*. Cambridge: Cambridge University Press.

Ruse, M. (2021). The Status of Humans. In *A Philosopher Looks at Human Beings* (pp. 5–20). chapter, Cambridge: Cambridge University Press.

Sartwell, C. (2021, February 25). Humans Are Animals. Let's Get Over It. *International New York Times*, NA. https://link.gale.com/apps/doc/A652898144/AONE?u=anon~221f6b8f&sid=sitemap&xid=1731867d

Spier, F. (2010). *Big History and the Future of Humanity*. Wiley. https://doi.org/10.1002/9781444323498.

Stanford M. (2020). The Cultural Evolution of Human Nature. *Acta biotheoretica*, *68*(2), 275–285. https://doi.org/10.1007/s10441-019-09367-7

Uttal, W. R. (2001). *The new phrenology: The limits of localizing cognitive processes in the brain*. The MIT Press.

Zwir, I., Del-Val, C., Hintsanen, M., Cloninger, K. M., Romero-Zaliz, R., Mesa, A., Arnedo, J., Salas, R., Poblete, G. F., Raitoharju, E., Raitakari, O., Keltikangas-Järvinen, L., de Erausquin, G. A., Tattersall, I., Lehtimäki, T., & Cloninger, C. R. (2022). Evolution of genetic networks for human creativity. *Molecular psychiatry*, *27*(1), 354–376. https://doi.org/10.1038/s41380-021-01097-y