The Philosophy of Research

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Abstract

At either extreme, "research" ostensibly is finding new information just to know it or for some purpose. Indeed, schools are established for people to learn what already has been discovered or how to discover. Usually, matters end here. Left out of conversations about research are deeper meanings of words like "knowledge", "education", "bias", and "objective". Students rarely encounter the more sophisticated "epistemology", "second order critique", and "ethos". Above all, the foundation of learning, the love of truth, rarely is touched, "educators" freely floating in the air just as confused as their students. This essay sets forth orderly thinking and development of research, starting with definitions, continuing with knowledge acquisition – context and problems, and ending with applying the lessons learned. Phenomena as data get transformed into information, information through epistemology (justified belief) becomes knowledge, and knowledge through ethos yields wisdom. Overcoming the bias problem is done through bootstrapping, identifying a reference frame. Against the background of knowledge types, epistemic (theory) and technic (praxis), emerge inductive (synthetic) and deductive (analytic) methods of establishing quality reference frames. Bringing it all together, we have a philosophy of research. We all as students with the core ethos of loving truth are ourselves processes embedded in dialectics, or unity of opposites that describes knowledge space, from the infinitesimal to infinity. As the etymology of "research" says, humanity is wandering in search of itself.

Keywords: *research philosophy, epistemology, reference frames, knowledge acquisition, learning theory, education philosophy, research bias, knowledge theory*

1. Introduction

> SOCRATES: Then the house in which order and regularity prevail is good; that in which there is disorder, evil? And is not the virtue of each thing dependent on order or arrangement? Yes, I say. And that which makes a thing good is the proper order inhering in each thing? Such is my view. And is not the soul which has an order of her own better than that which has no order? Certainly. And the soul which has order is orderly? Of course. And that which is orderly is temperate? Assuredly. And the temperate soul is good? (Plato, *Georgias*)

One day I asked my favorite professor Dr. Myrl M. Young in my first year in college Development of Civilization class, "how many books do you need to read before you can say you know the subject?" I forget his exact reply, but probably it was something like "several", "it depends on the subject matter", or "you never

can read too much." Years after in graduate school, I expressed my frustration with the plethora of philosophy journals publishing arcana few people would ever read. Articles in these publications typically are narrowly focused, and it behooves a person submitting an article to be keen on the genre of previous work, in particular, recent ongoing exchanges, as in our ethical concern over the sex habit of tsetse flies in attempts to control them in Oujda, Morocco. (Hint, this is a fool's errand, if you know anything about the tsetse fly habitat.) What do we do in a world in which we don't know how much is needed to get along, or why do we even bother to know much of anything beyond our noses? Reading and research fulfill either one's personal goals of learning or provide a platform upon which new knowledge can emerge and make us more substantial in life.

Above, I packed many concepts into a small space, and unless we focus on the meaning of each, we will have missed our understanding of how to go about research and subsequent learning. Let's look at some keywords: "narrowly focused", "knowledge", "learning", "platform", and "subject", among others. In the following essay, I put these ideas under a microscope and examine them to provide substance to my theme: research (re-search) is living (by nature recursive) the search for truth.

Students often are dropped into a learning environment without ever having been exposed to thinking about the goals of our exploration, save for some rudimentary mechanics. They are given what amounts to an "objective" exam, factually-based. "Where is Brazil?" "How much steel does China produce annually?" In advanced classes, an occasional "why" appears, prompting some roaming and ultimately speculating, not thinking of the deeper reasons. Can you really identify the ultimate reasons for World War I? Think of the word "ultimate", and you'll begin to realize the sparse content produced by so many commentators. Political mechanics, crumbling empires, nationalism, and territorial ambitions all were immediate reasons, each symptomatic of a way of thinking about core values. We find immediately in front of us our grandest goal, described by the title of this essay and Socrates. Truth depends upon order. Truth equates with good. 1914 marked a breakdown in order, unbridled hedonism, vanity, and pettiness wearing the cloak of national honor.

Strictly and etymologically, moving about in a knowledge space is called "research". We need to know what we are talking about before applying the word to anything, looking at the context, including word origins, or etymology. Upon knowing its essence, we then can address the "why" of research, since part of the answer will be bound up with the definition.

From my favorite source, *Online Etymology Dictionary*,

> research (n.)
> 1570s, "act of searching closely," from Middle French recerche (1530s, Modern French recherche), back-formation from Old French recercher (see research (v.)). Meaning "scientific inquiry" is first attested 1630s. Phrase research and development is recorded from 1923.
> *research (v.)*
> 1590s, from Middle French recercher, from Old French recercher "seek out, search closely," from re-, intensive prefix (see re-), + cercher "to seek for," from Latin circare "go about, wander, traverse," in Late Latin "to wander hither and thither," from circus "circle" (see circus). Related: Researched; researching.

A lot more is contained in these words than providing a quick history of "research". "Wander" is intriguing, an activity many instructors do not want their students to do in a term paper, thesis, or dissertation, surely not "hither and thither". As an animal driver would have the beast look directly in front when pulling a load, the school taskmaster wants the student to narrow the object of research on a single topic directly in front, a rebuke often the reward for interdisciplinary exploration to the left or right. Look at "from circus 'circle'", a phrase to which I will return in a while in describing our world of words. The very nature of language helps us to wander, although frustratingly, we, like the lost explorer, may return to the same spot from which we started.

I suspect a central question to students and even senior researchers is "what's the point"? So, you have discovered the glaciers have been retreating worldwide since 1850 or there is in a slice of a rat's hippocampus slow periodic activity through dendritic NMDA receptor-dependent Ca2+ spiking, meaning ephaptic (coupling of nerve fibers via local electric fields) interactions across neurons. For the former, an Internet search will yield a multiplicity of peer-reviewed research, and the latter can be found in *The Journal of Physiology*, Volume 597.1 (2019) page 3. Depending upon the question and the manner of asking it, these findings will be satisfactory. Again, though, they are specific responses to a specific question. No doubt, the non-brain-dead person will recognize "answers produce more questions", an oblique reference to the wandering and ultimately the circle in the etymology of "research". A lot of circularity and its creative aspect, spiraling, have to do with the language. Once we know their nature, a starting point for research can be found, as well as the answer to what it all means. Keep in mind Socrates and the meaning of philosophy, the love of wisdom. "Starting point" implies working towards learning about the order giving rise to the phenomenon you are investigating. Your research for "wisdom" will obtain a substantive answer about meaning.

2. What is knowledge?

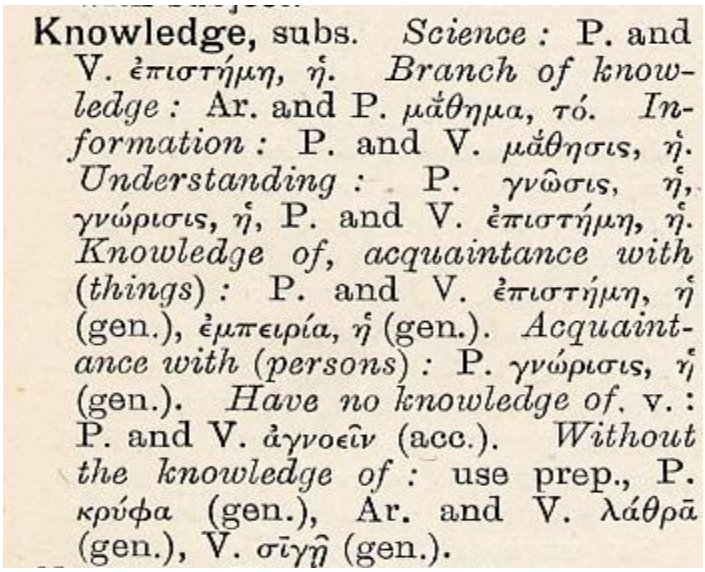
Above, I referred to "knowledge space". Our surroundings produce stimuli owing to two fundamental sources: photons and another only vaguely referred to as "processes". If you can think of a better word, try defining "consciousness", "ideas", "thinking", and words related to brain output. Go to the Towards a Science of Consciousness web page (*www.consciousness.arizona.edu/), a biennial conference I helped start back in the early 1990s, and I assure you we have not advanced one nanometer towards understanding what "consciousness" really is. A primary researcher in the field, David Chalmers, frames the debate in terms of "materialist" and "non-materialist", begging the question, "what ultimately is material?" Photons and "ideas" alike come to us, neither of which we know the origin or nature, only their effects, not unlike an engineer reading a waveform produced by electricity. My little excursion into the unknowns of fundamental tempers our enthusiasm in reaching definite answers. Instead of thinking "research" will uncover absolutes or "really" answer questions, let's say "knowledge" is a conditional finding, stemming from the love of truth. Already, we have a process philosophy.*

2.1. Definition and etymology

Words come either by pure invention or from context and history, more often the latter. History incorporates origin, implying “etymology”. Vocabulary experts refer to the “root words”, many from Indo-European origin, as in “altitude” coming from the Latin, “altus”, meaning "high" or “deep”. For knowledge, we have from the Online Dictionary of Etymology:

> **knowledge (n.)**
> early 12c., cnawlece "acknowledgment of a superior, honor, worship;" for first element see know (v.). The second element is obscure, perhaps from Scandinavian and cognate with the -lock "action, process," found in wedlock.
> From late 14c. as "capacity for knowing, understanding; familiarity;" also "fact or condition of knowing, awareness of a fact;" also "news, notice, information; learning; organized body of facts or teachings." Sense of "sexual intercourse" is from c. 1400. Middle English also had a verb form, knoulechen "acknowledge" (c. 1200), later "find out about; recognize," and "to have sexual intercourse with" (c. 1300); compare acknowledge.

Here is what the *Woodhouse English-Greek Dictionary* says:



Knowledge, subs. *Science:* P. and V. ἐπιστήμη, ἡ. *Branch of knowledge:* Ar. and P. μάθημα, τό. *Information:* P. and V. μάθησις, ἡ. *Understanding:* P. γνῶσις, ἡ, γνώρισις, ἡ, P. and V. ἐπιστήμη, ἡ. *Knowledge of, acquaintance with (things):* P. and V. ἐπιστήμη, ἡ (gen.), ἐμπειρία, ἡ (gen.). *Acquaintance with (persons):* P. γνώρισις, ἡ (gen.). *Have no knowledge of,* v.: P. and V. ἀγνοεῖν (acc.). *Without the knowledge of:* use prep., P. κρύφα (gen.), Ar. and V. λάθρᾱ (gen.), V. σῑγῇ (gen.).

Figure 1. Greek idea of knowledge (Knowledge – Woodhouse, 2019)

Numerous concepts are all bundled together: science, understanding, information, organization, and even worship. From these historical accounts emerge with the aid of information theory knowledge dependent upon quality. Because someone says something obviously does not mean it conforms to reality or is correct (found by others to be the case). Later, we will see how and why.

2.2. Knowledge in context

Like everything else, we reduce or cut the whole up to get “particles”. This means various ways of organizing what we see about us based on classification schemes, or taxonomies. We group what we see about us into categories, essentially abstractions. Mathematics and logic perhaps are the starkest examples

of these. Chemists assort all the substances around us in their most basic natural form as atoms into the periodic table of elements. Biologists refer to the "cladistic" method of relating organisms, a method based on an original scheme by Carl Linnaeus (1707–1778). Aristotle, though, illustrates how far back classification goes, exemplified by his *History of Animals.* Auguste Comte (Comte, 1830, pp. 30-31) sought to classify areas of study according to degree of precision – Astronomy, physics, chemistry, physiology, and finally social physics (sociology to us), For how knowledge is placed, we often see the data-information-knowledge-wisdom (DIKW) pyramid to describe the completeness of our collection of phenomena.

Figure 2. DIKW Pyramid (2019)

Data simply are the pieces about us – phenomena detected by our senses. They are isolated facts, like event dates, persons, geography, and so forth. In information theory, they simply are bits represented by zeros and ones. Assembling bits into something coherent results in information. General Grant led the Union army in the US Civil War is information. However, information may inaccurate or even false, as in General Lee led the Union Army, even though each component is data. Note that data can be false, too, as there being a Union air force. Epistemology, or justified belief, transforms information into knowledge. It is an accounting of how we arrived at a point of accepting an idea. Wisdom is how we "process" knowledge, such as relating it to a value system, applying it, and so forth. The U.S. Civil War was principally about slavery, and documentation confirms this. Wisdom is supposed to come out of the knowledge, as in not repeating the events that led to the war in the first place.

There are problems with the DIKW pyramid, not the least of which is how one category bleeds into another. With the flying horse example, the cells, themselves, may be "information" at one level – insofar as constructing the flying horse, and knowledge at another (our having identified the cells scientifically). Is a simple fact data or information? Is a sensor reading data or a fact? As with the cladistic taxonomy based on the Linnaean one, we can modify it as well, such as drawing lines showing feedback loops, where something in each level may change as a result of something else happening in another category. Organizing anything depends upon boundary conditions, these set by us with all the attendant issues of quantification, distinction, and selecting the relevant parameters. What

information is in one circumstance may be knowledge in another according to who is looking at it. We have to consider the the scope of each level. A pyramid implies a narrowing focus to wisdom, something more widely encompassing that bits. Nevertheless, the DIKW pyramid does usefully orient us towards focusing on the way we look at "raw phenomena" and gain meaning from it. It helps orient the researcher as a "to do list": gather the facts, organize them, evaluate them, and learn from the experience.

What is "truth" in the DIKW pyramid? Knowledge emerges after making sense of data; hence, it is a truth, but, for reasons explained below, we by no means are on stable ground. Depending upon the degree of confidence in the veracity, an observer may deem it (as this author has suggested), a "relative absolute", a conditional finding, one embedded and dependent upon other findings. Relativity theory in physics applies to knowledge assessment. Knowledge embeds itself in a very complicated matrix, or web.

3. The web

We all are familiar (unless you are a Luddite) with the world-wide-web and navigating it as if it were an endless ocean containing equally endless islands. Physicists use "fabric of space-time" to describe our universe, but I think "web" describes the innate form it takes and imparts to everything else. For those saying it is a human construction, think of a model about context, interrelationship, and the very way we communicate through language. You cannot apprehend anything except in terms of what it is not, in other words, "dialectics", or this "unity of opposites" describing the phenomenon. I referred to "knowledge space" above, answers leading to more questions a case in point. Let's see how this web is constructed. Our sense of the web comes by asking how far our imagination can extend, good, bad, or otherwise.

Figure 3. Chicken job – How chicken are *we* in exploring beyond a topic? (Kliban, 1982)

Another "war story" affirms the web's character. In a high school assembly, a reporter from the Portland (Maine) Press Herald talked to us students about how everything is interrelated; an event in China ultimately can affect how coffee is sold in New York, a rendition of what we now call "chaos theory". Can a butterfly flapping its wings truly and finally result in a hurricane in Texas? Events can be explained in terms of other events; they don't simply happen; they have reasons.

Who says webs have to be of any size or scale? How can we write about something we know little or nothing? Another way of phrasing this is "how wide a scope should be our research?" "Research", itself, is the answer, my producing a 49-page paper on pebble tools for an undergraduate geology class - where they are found, who made them, why they were made, when they were made, and how they were made....all questions familiar even to a cub reporter. You perhaps have heard that questions produce answers that lead to more questions, but as we go along, more detail often emerges.

We have Rene Descartes (1637/1912) to thank for our ability to miniaturize information. In 1637, he said in order to understand anything, we need "...to divide each of the difficulties under examination into as many parts as possible, and as might be necessary for its adequate solution. (Ibid., p. 15)… by showing we cannot conceive body unless as divisible"(Ibid., p. 76). To be perfectly correct, our knowledge space can be reduced at least to a size of $1.61619926 \times 10^{-35}$ meters, Planck scale. Any description of anything can in terms of its Planck-scale "particles", each related to the next, and multiples thereof. This is called "reductionism". At such point these particulars can be compartmentalized according to taxonomies.

We should observe in passing a phenomenon I call the "chain effect"; more links weaken the overall chain, each link dependent upon the others for the ability to remain as a part of the whole. Information more often than not is interdependent in a similar way. If something is found to be false, the other pieces of information dependent upon it also may be "contaminated".

We are in exceedingly complex times, and it is not getting any simpler. One study estimates scientific knowledge is growing 8-9% each year, meaning a global doubling every nine years (Van Noorden, 2014). The U.S. National Institutes of Health, National Library of Medicine has on its website an article by a doctor who wrote in 2011:

> It is estimated that the doubling time of medical knowledge in 1950 was 50 years; in 1980, 7 years; and in 2010, 3.5 years. In 2020 it is projected to be 0.2 years—just 73 days. Students who began medical school in the autumn of 2010 will experience approximately three doublings in knowledge by the time they complete the minimum length of training (7 years) needed to practice medicine. Students who graduate in 2020 will experience four doublings in knowledge (Densen, 2011).

Regardless of the figures used, suffice it to say, the amount of information is not decreasing. We will get to the problem of winnowing out what is knowledge from information and information from data later on. What we need to keep in mind at present is the more detail emerges and thrashes our senses, each part coupled with the other details also becomes a detail. As a person becomes dependent upon the

accuracy of detail to generate other knowledge and to make things function in society, so too the chain becomes weaker when more links are added.

Just by invoking the 5 Ws and H recursively, it is amazing the resulting quantity of information. In college, my English teacher gave us a standard exercise of writing ten pages on the head of a pin. After laughing about the play on words, recalling how Medieval scholars tried answering how many angels can dance on the head of one, we saw the challenge. Today, the answers immediately jump out – description (sizes, shapes, materials, etc.) and manufacturing methods, history, uses, and so forth.

If you realize our world is a fabric made up of adjacent molecules, it is not difficult to conceive how the movement of one affects the next, and so on down the line. You can extend indefinitely, as well as contract. Another way of conceiving the situation is looking at a spider web, and if you have trouble imagining one, the next time you see a web, go up and touch the outermost edge and see what happens. Assuming what comes out is not lethally toxic, you can publish an article in a peer-reviewed journal to help you gain tenure. "Billiard ball interdependence" describes chaos theory rather accurately, albeit simplistically. For sure, even an average high school student could comprehend the idea.

Our conveyance of ideas by language evidences another web embedded in that of phenomena. Getting back to our pin example, it is easy to see how one page could generate the next. In fact, at the unit level, language is like this, each word definable in terms of others. Take Merriam Webster's (2019) definition of "cat", for example, a carnivorous mammal (*Felis catus*) long domesticated as a pet and for catching rats and mice.

Right out of the box, an astute observer recognizes - aside from the Latin name - the paucity of the definition, immediately thinking of other mammals who could be great mousers, like ferrets. The first clue about the web of definitions is the Latin, the English "cat" derived from the base, or root words "Felis catus". However, the trail does not end here, because Latin, like all languages" has its own web.

Each word can be defined in terms of others. Simply look up in a dictionary "a", "carnivorous", "mammal", and so forth, and an ever-expanding palette will appear, but as you do this exercise for each word, there will be a loopback or re-use of a word already examined. In essence, we have a matrix of language. Within the web lie tautologies, words whose meanings are in terms of others in the same web. Yet, the web is dynamic, it growing as new ideas are encountered. A mechanical exercise, like hopping from lily pad to lily pad in a vast pond, illustrates the interdisciplinary nature of exploration – unless, of course, you wish to remain on the same lily pad for the rest of your life. Word associations, concept maps, the thesaurus, dictionaries, and semantic maps illustrate language webs. Numerically, how large are these webs? The 1989 (latest) 20-volume Second Edition of the *Oxford English Dictionary* lists *171,476* then currently used words. Wikipedia says *The American Heritage Dictionary of the English Language*, Third Edition, has 350,000, but linguists agree that language is dynamic, word frequencies vary, and it is impossible to get an accurate count. Each word is a node, but draw a line from it to the related words, and you'll have what pretty much will be a solid figure. Chances are that no one has actually tried creating a language web of this type.

Without exploring the origins of language or entering into the unresolved controversy about words generating ideas or vice versa, suffice it to say we are in

a web of words. Now you know you are in one, aside from your goal (another location), what about the starting point? How do you determine it? Does this sound familiar - “Wander hither and thither”? You don't want to tramp around like some beggar, search engine in one hand and grant application in the other, just searching for knowledge, now, do you? I'll tell you how to spiff yourself up later on, but let me end this section by emphasizing the interdisciplinary nature of knowledge and the webs, themselves.

Over the centuries, intellectuals have carved out their own empires, cynically regarded as fiefdoms predicated upon the adage “knowledge is power”. Make a discovery, create the vocabulary, and hope others will become dependent upon what you have found. Ask a liberal arts scholar to attend a specialty conference and report to you their understanding of the proceedings. It is not unusual to find the attendees, who are themselves specialists, not able to understand each other's papers. Information transformed into knowledge has become so compartmentalized, even the desirability of learning various subjects is thwarted just because of the vocabulary. The more specialized a subject, the fewer people can understand it, and conversely. Cartesianism, although an essential knowledge microscope, inhibits knowledge dispersal. “Interdisciplinary” means findings are related to each other, and if they are separated by language, the whole knowledge web is compromised. The fabric of understanding no longer can clothe research. Still, the knowledge points, individualized or collectivized, need integrity.

4. Problems of knowledge

4.1. Objective knowledge

Everyone wants to be right, and you want to select a starting point so you'll wind up correct. Too often, a researcher, particularly a novice, will encounter the admonition, “be objective” (Mulder, 2019), because if s/he is opinionated, vital information may pass by. Gazillions of papers and books have been written on the subject, and it would take more pages than ever to recount just a small part of the discussion. Yet, it is essential to state its essence, for the response contains part of the philosophy of research.

“Objective” theoretically means something standing apart of any observer, although all observers will see the same thing … well, an object standing on its own. Other words are “neutral”, “absolute”, and “unbiased”. The opposite is “subjective”, a view expressed by an individual from her/his own perspective. The person sees what s/he wants to see. As a sidebar, other observers may report a subject's views, and their report theoretically may itself be objective. I think it is legitimate to use the word “truth” synonymously with “objective”. We'll get to “truth” in the next subheading.

Three views of objectivity are consensus, coherence, and correspondence. An “objective” (Mulder , 2019) view is an absolute everyone will realize in the same way, a “consensus”, common agreement one of three basic criteria. If everyone says X is Y, then X=Y is “objective”. Coherence, the second, is making sense, or “hanging together”, “consistency” a watchword. The third marker is correspondence; what we see or experience through our measurements is really coming from an object, and we describe it accurately. Of course, the weakness is knowing the actual nature of something. Otherwise asked, although asked

somewhat sophomorically, “what is real?” “Real”, “truth”, “objective”, and ”absolute” … are not these what we all desire to know?

What are our reality, truth, and the love of these?

From classical Greek times and through the present, humans have sought “final” answers, and such motivates research. Eastern philosophers refer to “Maya” (2019; Swami Vivekananda (1892).), or illusion. What we see is not the ultimate reality.

Plato in the seventh book of his *Republic* wrote of our presence in a cave and chained, forced to face a wall. Behind the audience are parading persons with silhouettes of objects mounted on poles. Behind is a fire causing shadows of the silhouettes to appear on the wall. People's ideas of reality are the shadows, and when led from the cave into the brilliant sunlight everything is real, or true.

Figure 4. Plato’s Allegory of the cave (Mito de la cavern, 2019)

How willing are persons to leave their metaphorical cave? For millennia, philosophers have identified problems of truth, ethics, the “real”, and the nature of space and time. The Renaissance followed by the Enlightenment, literally shined light on Medieval superstitions, myths, tales, and fables. The “natural philosophers” then subsumed many theoretical developments in the field of thinking about thinking (“love of wisdom”) and physically investigated the world about them. Most scholars are quite familiar with Boyle, Bacon, Descartes, Leibniz, Newton, and Kelvin. While they produced “objects” of investigation in the form of what we today might call “knowledge”, it more significantly was the process of investigation contributing more to how we investigate now. Behind all this was the ethos of virtue, humanity doing the best it can do, seeking to know who we are and why we are here. Set apart from the rest of this planet's organisms is our enhanced ability to process events in space-time, i.e., remember, analyze, and predict. In essence, if we are to ascertain regularity in this space-time fabric, we can have a better idea of how and why we are placed within it and where to go. Of course, there is the undercurrent of desire to control our future. As an ethical aside, our abilities mandate caring for the environment, including the animals, for their integrity depends on our judgements.

So, we see the search for truth may not take us to anything we can call certain; it seems so elusive one legitimately may ask not only how we may recognize it, with many asking why even bother? It is within ourselves the Greeks might say. "Know thyself." We are true to ourselves. The Greeks knew a virtuous person doing the best of which s/he was capable, physically and mentally. Everything and everyone may be an allegorical shadow, compared to a Platonic ideal, yet "virtuous" means venturing to make our world as close to ideal as we deem possible. How far are we willing to venture from the interior of the cave?
Plato and Aristotle argued the highest form of happiness is the search for truth. It is what life is about and signifies "high road ethos". Ethos refers to core values, what is important to us. Animals survive, and although they have "consciousness" and even emotions (Allen, 2016; Animal Consciousness, 2019), one distinct difference remains: our greater ability to extrapolate from the past and project to the future through a form of abstraction we know as "synthesis". We will get to this in a moment. First, though, the problem still is in front of us – how we arrive at truth. How do we get to obtain knowledge?

4.2. Epistemology

Criticisms of the DIKW pyramid include distinguishing information from knowledge. A branch of philosophy known as "epistemology", justified belief (Epistemology, 2017; Steup, 2005) imparts value to information.
Some ways we know things include:

- Tradition – It was always done previously and it worked. Tales, myths, parables, and the like stabilize ideas and customs. People relying on tradition as a way of knowing truth often come from places in which there are no written accounts, i.e., history (Eliade, 1954).
- History – This is a written account of what happened, something we take as courses in school. Time goes from circular in the orally-based societies to linear where things are written down (Ibid.).
- Rationalism – This word also refers to "rationality", or identifying, classifying, analyzing, synthesizing, and so forth. One thinks of logic and mathematics. Also, think of Descartes. Overall, logic has a direct application in social analysis, as in game theory and simulations. Projecting events based on the past depends on our ability to make assumptions and study their consequences. Experimental scientific methods rely on logic, hypotheses as the starting points.
- Empiricism – We know by observation through the senses, and with experience, extrapolating from the past and projecting to the future. Empiricism cannot stand alone, for there has to be a way of making sense of the phenomena, the other epistemologies of tradition, rationalism, and so forth.
- Scientific methods incorporate two or more of the preceding. More will be said later about the hypothetico-deductive method, a technique borrowed from logic.

Reams of literature have been generated over epistemology, and a multitude of university and college courses has been created to address knowledge generation

problems, problems not likely to be resolved here. Suffice it to say, though, epistemology is at the core of knowledge quality standards.

4.3. Dimensionality

Dimensional limitation is aptly described in Abbott's (1884) *Flatland* of two-dimensional beings. How is it a dot will appear on the horizon, widen to a line, become a dot, and then disappear? The three or more-dimensional individual knows it is something like a sphere coming down from the top and passing through the plane, the two-dimensional world. Or, it also is perceived as a tiny object pushing out in all directions, retracting, and then disappearing. What of our four dimensions, where we seem incapable of locating that which gives rise to the effects of intelligence, mind, consciousness – all forms of mentation, and even ideas themselves?

Certain conundrums appear to be out of reach of our understanding, be it Escher drawings, wave-particle duality, or the set of all sets problem. How could a staircase be going up and down at the same time? How much can we reduce something – the smallest possible, and if so, what does it become? If it disappears, what is the boundary condition? Then, if we include something in a collection of things as a set, what contains the set, itself? Seeming paradoxes like these pale in comparison to our not knowing what time is all about. We can go on about "mind", absolute motionlessness (or anything), and our very origin in arguing about the seeming irreconcilability of apparent absurdities because of dimensional limitation. To exemplify the problem, I refer to persistent dynamism in the face of pure stasis.

4.4. Persistent dynamism

As our physical world changes, so perforce does our knowledge about it. A bit of physics coupled with philosophy help characterize another problem of knowledge. Quantum physicists refer to the "uncertainty principle" (Heisenberg, 1959, pp. 38-44; Heisenberg, 2019; Heisenberg, 1983), meaning first measuring a particle's momentum then position will yield a value different than measuring the position and then the momentum. Of course, by the time we try the measurement again and in a different order, the particle will have moved, thus changing the values. At what many physicists regard as the smallest meaningful scale, Planck scale at 1.61619926 × 10-35 meters, entities of this size (regarded as "particles) "flick in and out of existence", as one physicist says (Hawking, 2017) and which is being scrutinized intensely.

Since time immemorial philosophers have observed like Heraclitus "You cannot step twice into the same river, for other waters and yet others go ever flowing on. They go forward and back again" (Harris, 2017). If everything is in a state of flux, then, what of the dialectic, movement existing in terms of stasis? Parmenides (c. early fifth century BCE) said

> One path only is left for us to speak of, namely, that it is. In it are very many tokens that what is, is uncreated and indestructible, alone, complete, immovable and without end. Nor was it ever, nor will it be; for now it is, all at once, a continuous one. For what kind of origin for it. will you look for? In what way and from what source could it have drawn its increase? I

> shall not let thee say nor think that it came from what is not; for it can neither be thought nor uttered that what is not is. And, if it came from nothing, what need could have made it arise later rather than sooner? Therefore must it either be altogether or be not at all. Nor will the force of truth suffer aught to arise besides itself from that which in any way is. Wherefore, Justice does not loose her fetters and let anything come into being or pass away, but holds it fast. … And there is not, and never shall be, any time other, than that which is present, since fate has chained it so as to be whole and immovable. (Parmenides, 544 - 450 BCE)

Heraclitus and Parmenides represent two diametrically opposed poles in the dialectic, unity of opposites, convergence of two realizations, and the motionless-dynamism spectrum again calling into view our dimensional limitations.

Somewhat as a sidebar focusing on the idea of our world as Heraclitus describes is the presence of electromagnetic fields. We know these exist only because of the effects, as in voltmeters, ammeters, and ohmmeters. Yes, they evidence the behavior of electrons, and we even have been able to photograph atoms. However, we are not able to observe directly the hadrons composing protons, only the effects (Quark, 2019). Similarly, mentation is observed by what animals (including humans, of course) do. In both of these cases, we cannot identify specifically what gives rise to Planck-scale "particles" nor ideas, not unlike observing an ocean wave, never capable to trace its origin from tectonic movement through what gave rise to the Universe in the first place. This "unmoved mover" problem permeates our incapacity to locate the foundation of who we are and what we are about. Go back to the excellent 1892 explanation of Swami Vivekananda, who said Maya simply describes the unity of opposites; we cannot escape it, any more than Abbott's two-dimensional people could get out of Flatland. Like Plato, he says there is something beyond Maya, perfection.

If it all is illusion and we cannot resolve even the most basic and obvious contradictions because of dimension limits us, then why go on? Remember, our conclusions and renditions of what we think are paradoxes come from us, and there is a way of managing the problem.

4.5. Second order self-critique

Science depends upon our ability to extrapolate from the past and project to the future accurately, the emphasis here the word "our". The integrity of quality in doing so still rests with the observer, though be mindful of others who are supposed to review and report on integrity have their own biases. In other words, we have a never-ending chain of biases, each link having its own issues.

Confirmation bias means finding information substantiating an already-held view. One antidote given by professors is to pass out a piece of paper to students, telling them to write their most staunchly-held opinion of something and then instructing them to write a term paper defending the exact opposite. However, two opposing views can be held with equal integrity, owing to insufficient knowledge. Peer review is supposed to handle bias, insufficient research, failure to support arguments adequately, and so forth. For reason discussed elsewhere (Horne, 2018), peer review is fraught with serious deficiencies, not the least of which is solving the objectivity issue.

Humans cannot escape themselves and get outside to look inward, while perforce such is the origin of discovery, everything following shaped by our own natures. Think of yourself a can filled with red paint. Anything dipped in it will emerge with red. The singularity bound up all the physical laws of the emerging universe, every part of the domain infused with the same processes. Second-order cybernetics recognizes the observer also is a subject for observation. In learning of the concept, researchers will look up "Copenhagen interpretation", "double-slit experiment", and "Heisenberg uncertainty" to find what we see comes from us. Calculus is founded on the idea of limit, our determining how precise we want a calculation. There are no absolutes, gods, dictators, or other authorities outside ourselves pointing to an absolute. Even if there were an outside authority, humans would still be stuck viewing it through themselves. Pick a good stance well, though; you'll need it for spiders lurking in the research web.

Look around you and think about what your senses are saying. Ask where those sense "organs" are. If you say they are not in your body, you might be an alien or an automaton. Otherwise, once you conclude the means of sensing things are inside you, then it has come time to find out more about yourself through introspection. To do so, gaze into the mirror. In this mirror exercise, most likely you will sense separation from yourself, not unlike listening to your recorded voice. In the mirror, you are observing yourself through yourself.

You simply do not look at it and see a reflection because reflection has a source. Initiate the exercise by consciously thinking about physical characteristics and more significantly what generates the image. Reflect inward. Think of an infinite regression of images, as in an infinity mirror (2019) when a mirror is placed on either side of a person and s/he observes the result, where one image for its existence feeds off the opposing one. What is the source of the images? Go to the thesaurus and look up synonyms for "ultimate" and "furthest" to describe how your mental excursion will take place.

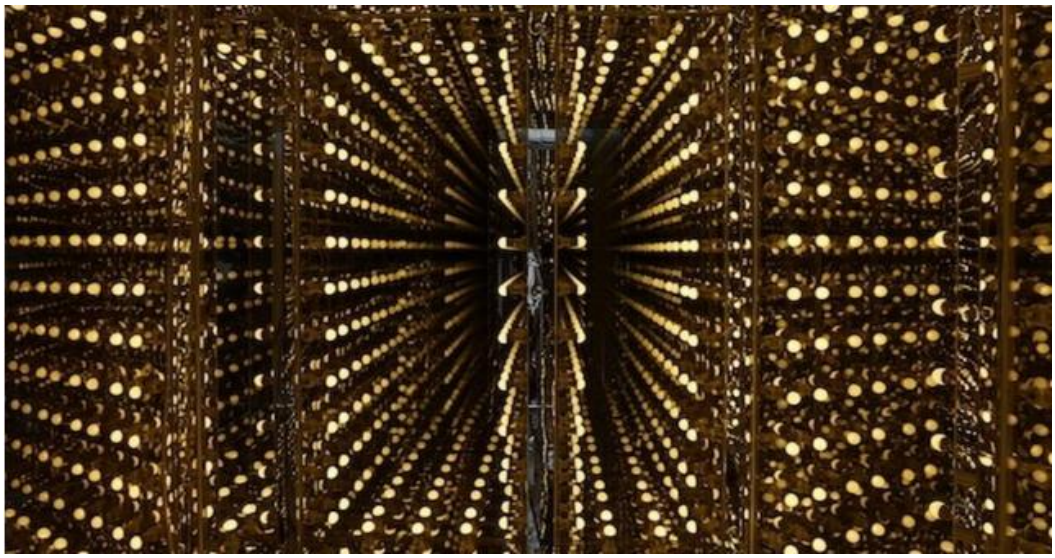


Figure 5. Infinity mirrors (Rosenthal, 2014)

Escher's drawings are similar in concept, as in:

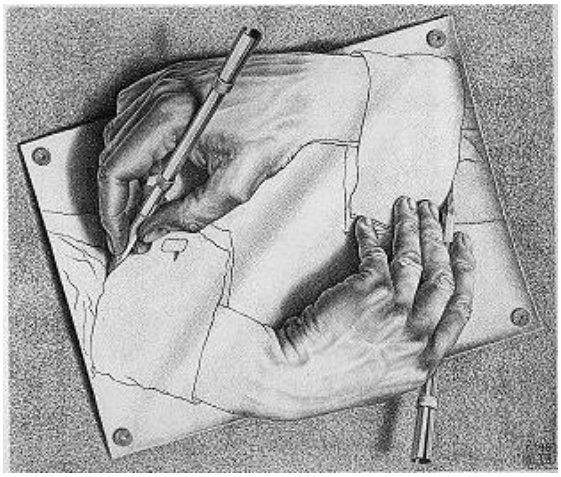


Figure 6. Escher's 1948 Drawing Hands (Escher, 2019)

Schematically in infinite regress, we have: |Mirror ← Object → Mirror|

After gazing into the mirror for a while there will be this sense of your separation from the image in the mirror, where you can "see yourself", not unlike the sensation of listening to your own recorded voice. For enrichment, record yourself and play it back while doing the mirror exercise. You will be looking at yourself as an object outside of yourself. The longer the gaze the deeper is the introspection. Ask, "what gives rise to the entity generating the image?" We become apart from ourselves, realizing ourselves - introspecting on our core - through ourselves. I wonder how a virtual reality rendition of ourselves work, as in our interacting with it?

You should be starting to realize how important the observer is in the observations you make. You, the observer, are a reference frame, the platform on which you stand to locate everything else. By what method we construct is superimposed on everything observed. How do you address human bias? As a more profound and consequential question, "is order innate or do we create it?" If you create it, how does the idea come to you? Does it not already exist "out there"? I will let the question rest here for a moment before returning to it shortly; meanwhile, say it is part of what will come down the line in searching for the truth. Let's get back to our bias problem that faced you in the mirror.

First, the observer does "contaminate" the integrity of the observations by selecting what is to be observed, how it is to be observed, the reading of measurement devices (also considering physical/sensory issues - as in compromised eyesight), limits of computation (as in calculus), and interpretation of results. Second, the bias of the observer is part of the observed (biased person observing her/his bias). Again, you can not escape yourself. This second-order cybernetic process now is becoming recognized as a vital part of scientific methods. We see and understand ourselves through ourselves; we the observers become part of the experiment. I think this diagram says it all:

Figure 7. “Recursion is repetition” says the philosophy professor of redundancy professor of philosophy

All the foregoing in this section says knowledge problems start with us.

5. Where to start in the web

5.1. Reference Frames – The bootstrap basis of structures

Let's get back to our environment in which we are located. Our universe is a web, and I defy anyone to locate its center. Physicists have arrived at the same conclusion, any center existing everywhere and nowhere. If anyone attempts to locate an absolute, another surely will point to another and with the same degree of explanation, confidence, and ability to validate the finding. Einstein famously referred to “relativity”; it all depends upon one's frame of reference. Yet, if we cannot escape ourselves, where do we begin researching? If you are in a technical world, there are already established reference frames.

Look at your measuring device for length, weight, temperature, and so forth. Those marks are gradations based on a unit; now, from where does any unit come? In Feudal times, it was the king's foot. At the very beginning of the Romantic period, confirming the Enlightenment (Age of Reason), philosophy, and throwing off the chains of parasitic royalty, the scientists who had gained ascendancy opted for something we all are beholden to, Earth, itself. No, angels do not dance on the heads of pins. People dance on the ground you're standing on.

From Earth's dimensions are derived the units for the metric system. Ask a space traveler where s/he is, and don't be surprised to learn about far from Earth the craft is. Every measurement we take is in terms of a reference frame. Standards organizations, like the International Organization for Standardization (ISO) set the pace worldwide which units we use to judge products, procedures, and the like, all the measurements coming from *Système International d'Unités* (International System of Units), the physical artifacts deposited in Sevres, France, Gaithersburg, Maryland, and other repositories.

These weights and measures units come about by agreement. Do you notice the similarity to language as a web? All quantization depends upon standardization. A horse does not deserve its appellation because of any intrinsic property mandating a word, only because of an utterance perhaps made tens or hundreds of thousands of years ago. All the people in their loincloths bobbed their heads when the alpha male or female grunted the sounds while pointing the animal, and from then on, everyone knew what was meant by the grunt. Only now, we have millions of these grunts, coming from various sectors of the world, converging in translation devices, making one society able to communicate with another.

Humans are so proud of their "reason", and, it is true their capacity to extrapolate from the past to project to the future differentiates them from the rest of the species. Standardization only is a collective sigh of relief that individualized biases about quantity can be merged into a collective bias. Still, they are no closer to Plato's forms than the dumbest of monkeys. So where are we, now? All of the above examples and descriptions boil down to one word: "bootstrapping". Logicians aver their premises, rules, and whatnot. Standardized metrics will calibrate everything according to an agreed-upon quantity of atoms or described process. The space traveler will phone home about how far s/he is from Earth, and so forth. We think

As if...

We may never know if "free will" exists, a unit measurement is universally the best for all time, a person is good or evil, or anything else for sure. Just think:

$$\mathbf{E = mc^2}$$

"E" depends upon the reference frame of c^2, the speed of light in a vacuum, multiplied by the mass. The two variables and the reference frame is the ensemble, itself a reference frame. Every element in our knowledge world has the same status, dependency upon something else and a reference frame. Perhaps, by bumping around in this dark room, our knowledge world, we may find the exit door. Now we know we don't know, and we don't know if we do know, now what? But, you have to start from some place to end somewhere.

A reference frame is not simply an anchor point, a calibration standard, or commonality allowing us to communicate with each other in a consistent manner. It enables us to cut through an amorphous fabric to create shapes, and it sets up discrete, or deductive logic. Keep in mind the words "bootstrap", for we are going to go over the thinking to build one. Now, let's be logical.

5.2. A little bit of logic

There is a way of building a reference frame. Remember the above discussion on epistemology, justified belief, or way of knowing? "Rational", in consulting the *Etymology Online* website, comes from "ratio", to calculate. Rationalism is the most basically quantifiable way of knowing. In mathematics, to a grade-school student, ratio is one number divided by another. A more sophisticated student knows this special relationship as one describing rates of change, grouping, partitions, and set inclusion. What does "logic" mean? Logic instructors will say it is setting the standards for the way people reason, separating good arguments from poor ones, and applying criteria of validity and strong inference. These are platitudes, not really describing what the foundations are. More profoundly, as the etymology, it comes from the Greek "word". My favorite is James K. Feibleman's (1979) "Logic is the theory of order." Here, you can bring in Socrates' utterance appearing at the beginning of this paper. The search for truth is about finding order, and upon order our knowledge depends. Logic is the language of innate order in the Universe.

Logicians are keenly aware of a binary (bivalent) space filled with two distinct symbols, a numerical version consisting of zeros and ones, a palette – stealing a

word from the artsies - quite familiar to machine language computer programmers. The Table of Functional Completeness (ToFC) describes completely how two things can be related to each other.

p	q	f_0	f_1	f_2	f_3	f_4	f_5	f_6	f_7	f_8	f_9	f_{10}	f_{11}	f_{12}	f_{13}	f_{14}	f_{15}
0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
0	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1	0	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Figure 8. Table of functional completeness (image by Horne)

Each one of these functions has a meaning, beginning logic students learning f_1 is conjunction, f_7 disjunction, f_9 equivalence, and f_{13} material implication. If you are an iota as fanatical about logic as I am, you'll be racing to your logic books to find more, but I'll insert an advertisement for my "The core of logics" in *Philosophical Perception of Logic and Order* as a primer, or you can search for related papers about my three-dimensional hypercube on www.academia.edu and elsewhere.

At the most basic level of the simplest of logics, bivalency, is the idea of magnitude and how we describe its emergence. Binary logical space is generated from the concept of number, incompletely described famously by Peano's Postulates purporting to explain the origin of numbers. It is outside the scope of this paper to explain Peano's deficiencies (as in not having any postulate for unit magnitude). Without entering into the technical details of its complexity, it by no means has been established the source or its nature (Russell, 1919, p. 7; 9). Suffice it to say, this computational basis of logic is the most definable, discrete, and precise epistemology. I will go further and say logic is its language of the most solid of ontologies (study of existence, or being), order in the Universe.

The ToFC generates both all of mathematics and logics. In fact and to be precise, 0 and 1 do. Go back to the unity of opposites, 0 symbolizing what is not and 1 what is, stasis and motion (recall Parmenides and Heraclitus), or the infinitesimal and infinite. Ours is a binary world, your looking up "digital physics" confirming this. Most people can count; how do they reason? Logic (th structure of reason) and math converge as one system (thus resolving the question of logic coming from mathematics or vice versa). I will boldly assert the interchangeability of logic and math in explaining our world.

In logic, reasoning, or argumentation, is divided into two basic areas: deduction and induction, or closed and open systems. Deduction means if the premises are true, the conclusion is guaranteed to be true. The conclusion is contained within the premises. Induction means the conclusion extrapolated from the premises only has a degree of probability (between 0 and 1, not either). A third argumentation method is abduction, extrapolating premises from a conclusion, though the jury is still out on whether this is only another form of induction. Now, let's look at some details on deduction and induction, leaving abduction to junior faculty needing another article to get tenure.

Let's look at deduction first. Premises are assumptions, or starting points. “You have to start somewhere.” If we are the ones creating order, we are the assumption. Calibration is an analogy; the initial value is settled upon (often by convention), and everything else is expressed in terms of it, as in the kilogram, meter, or second. It doesn't mean the standard has some deep or absolute truth value, merely a frame of reference. Remember the “as if” from above? Deduction has its role in closed systems, such as in logic and mathematics. So too, it is with games, where rules, players, the board or field, etc. all are used as a "testbed" for possibilities, the winner the "conclusion". Once the game ends, we can trace back through every sequential step of the interactions, just like a logic, math, or geometry proof. In essence, then, a logic reference frame is a starting point and definitions, rules (axioms, postulates, and derivations as theorems) are used to "navigate" a possible space to see what outcomes are possible. Even with logic as a device for ordinary language translations, the idea is to see what various juxtapositions of meanings and words are possible to assess the likelihood of outcomes, albeit this use being very clumsy, at best. There does appear, though, a scaffold of thinking on which the words hang, albeit tenuously at times.

Deduction” means if one accepts the premises, the conclusion must also be accepted. The conclusion is contained within the premises; it results from a recombination of one or more elements in a system. All the elements in this closed system are known. A conclusion from these knowns really does not contain any new information or knowledge, at best a new perspective from a novel way of combining premises. Think of a kaleidoscope, where all the pieces of glass and only those pieces are contained within a closed space, a tube.

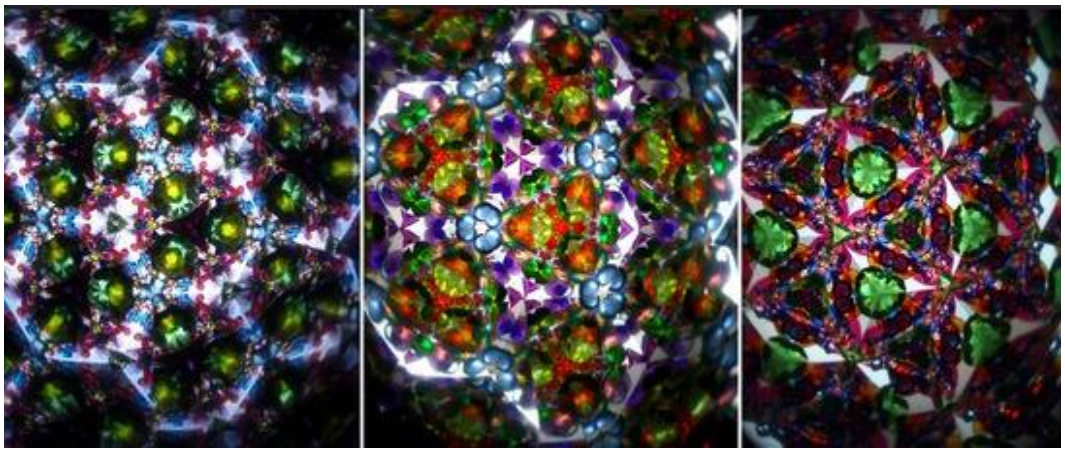


Figure 9. Conclusions in a deductive kaleidoscope proof
(Kaleidoscope, 2019)

However, rotating the tube will create new arrangements from various arrangements of glass and reflected by mirrors. The tube, glass, and physical parts of the kaleidoscope are analogous to the definitions of a logical system. The way of moving the tube and configuration of the kaleidoscope parts are likened to the rules. The pieces of glass are the premises. What we see is the conclusion. How many designs may be generated could be astronomical; yet each result is only a sample of the totality, or whole, of available patterns.

The other method of logical inference is induction, where a conclusion can be generated from the premises with a probability less than one. Conclusions are only probable, not certain, as in deduction. Induction also is known as "synthesis". The whole – the conclusion – is greater than the sum of the parts before us. Statistics is a form of induction, where a researcher identifies examples and attempts to describe a whole. Survey research relies upon sampling, like asking questions of randomly selected persons in order to conclude what is true of the whole population from which samples were taken. Using the kaleidoscope, the more images we get the better idea of the potential, or complete, set of patterns. While induction often is regarded as an abstract process, it also reflects the very way we process the world about us, a familiar example of photographs printed in newspapers. Look closely at the dots making up the picture.

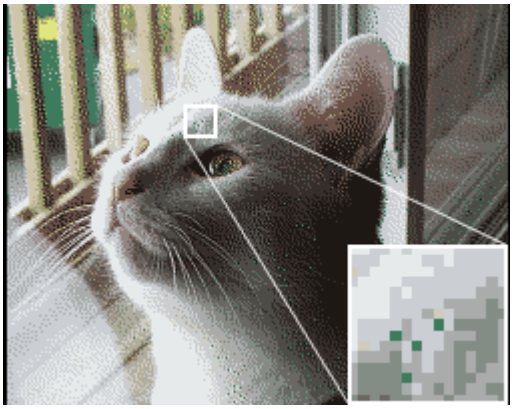


Figure 10. Pixelated photograph (Pixelation, 2019)

Television and computer screens rely on the same types of dots known as "pixels", each carrying a piece of information about the whole picture. If you back off from the newspaper or screen you will see what looks to be solid. The more dots are identified as samples, the more you will know the whole image. That is, you are using induction.

Quantum physicists are all too aware of breaking down in a Cartesian fashion anything to the Planck scale referred to above. Our very ocular physiology is inductive in character, where the rods and cones structure of our eyes accepts photons, those photons entering an atomic shell, thus forcing an electron out to be transported to the nerve synapse and ultimately to the brain.

Scientists, as a way of seeking truth, use a similar bootstrap method, formally called the "hypothetico-deductive method". I said above that scientific methods were an epistemology and the experimental scientific method borrows from the epistemology of logic. A hypothesis is created to explain something. It is tested to see if it is correct. Others outside and independent will attempt to achieve the same results (repeatability). If the hypothesis tests correctly in multiple and independent environments, it is accepted as the explanation. The more people confirm the results, the stronger the conclusion becomes.

If the premises affirm the conclusion deductively we have a theorem. The premises affirming the conclusion with a probability of less than one constitute a theory. Both serve as jump-off points for further exploration. They also are reference frames, or, well ... bootstraps. You pull yourself up by them. The root

of both is the Greek word *theōros*, or spectator. Does this sound familiar? Are we not, though? And, where do you think the bootstrap is mounted?

Logicians and mathematicians are keenly aware of the objectivity and reference frame problems, and they resolve them by stating up-front that reasoning depends upon the setting forth of assertions, or premises. From these are derived other assertions, or conclusions. In between lies a vast unknown gulf called "inference", a word we know as much about as "consciousness". Alonzo Church showed a logic professor can tell a student a correct conclusion has been derived and say the same for each step leading to it. To date, we cannot tell the student an algorithm for all logic problems, only some techniques in the form of definitions, rules, and example proofs (theorems). A numerically-based decision procedure exists for propositional arguments, more complex arguments with "all" and "some" not so well defined.

These same logicians and mathematicians will talk about "self-evident" truths, or axioms, as starting points in arguments. Think of your sleeping out in the middle of a field one night and waking up to find yourself covered in snow. You start clearing a path, ultimately to leave the area. Upon closer philosophical inspection, several difficulties emerge, not the least of which is who you are and the way you settled on how and where to go in relation to where you are. I chafe at how logicians so confident about their "self-evident" starting points: primitives, rules, and so forth. A suitable answer is the logician simply wants to explore outcomes based on assumptions, and assumptions are what references frames are all about. So goes it for addressing the bias problem. We start with ourselves, making ourselves the reference frame maximally explicit. As Nancy Sinatra's 1966 song went,

> These boots are made for walking
> And that's just what they'll do
> One of these days these boots are gonna walk all over you.
> (Be careful with that bias, though.)

6. Implications and applications

Now we know what research is, where to start – references frames - and have some idea about how to assess quality by epistemology, even though there may be some "fallout". Answers come in the form of how much research should be done, the type of research, the objective of schooling, overcoming the bias stigma, and even whether to do research at all.

6.1. The role of statistics

Logic, as you may have surmised, is not simply an academic exercise. A major question above was "how much research is necessary?" Given our dimensional trap, it is impossible for any one of us to know everything, simply because of how the physical world is composed. Remember the solidity issue? No matter how many points are identified, you never can capture the whole object. Even in sampling human populations, it is impossible to sample them continuously under all conditions and bring the results all together to describe the population as a whole for all the conditions. It is by no means settled there is continuity. If

everything is discrete, as the digital physicists think it is, then, both Heisenberg uncertainty and Hawking's observing particles flicking in and out of existence bar total identification and knowledge. There is always something we do not know. However, the more data points or pixels we have the closer we come to what appears as solidity. Think of the calculus; it is the same idea of setting limits. We do. A pollster does the same thing in assessing how a population thinks, votes, or just about anything else. S/he asks a number of persons in a total population. This method of setting limits and approximation is what researchers do in determining how much is enough. Their critics are the ones identifying what they think are gaps, those samples the researcher did not use in making conclusions. How much should a person read? Never enough, and this is one reason why knowledge acquisition never ceases. As they say, learning is a life-long process.

6.2. How to address the bias problem

If we cannot escape the bias problem, how can a pretense of objectivity be maintained? Advocate it all you want, but, unless you are a machine, you never can escape yourself. Even a machine will have a bias imparted to it.

A lot of older folks may be trapped in a writing style, characterized by passive voice, anything except the first person, and trying to cultivate 19th and 20th century objectivity. Aside from yourself having an opinion, even if there were worldwide consensus, it still would be a human bias. There are no absolutes standing apart from human judgement. What to do? Get rid of the clunky style, first. Quit being phony. Go naked and be yourself.

Yes, critical thinking, purposely arguing in favor the opposite of your views, and scads of documentation all help. Yet, you, like the one measuring or doing the calculus problem set the parameters and limits. Every point in information space is unique; it in an abstract way represents literally a point of view, a bias, be it yours or someone else's. Admit it. Inability to escape it requires substantiation, metaphorically making the soil in which the ideas are found as rich as possible. State the bias up front. Most important, provide its becoming, how it came to be. It needs an environment, a history, an explanation of how it is related to other biases. Provide peer-reviewed references, argue solidly, and, above all, let a high-road ethos – the love of truth as your core value, guide your journey with no personal axes to grind.

Make no mistake, if you run into a publisher or other situation demanding you feign objectivity, chances are you are seeing a masque covering up their biases. There is nothing like an honest handshake to seal quality knowledge exchange. The Greeks were right – be true to yourself and others.

6.3. The logic of episteme and techne

What is research? There are two approaches. We know what we are looking for, as in finding answers to specific questions and there is exploratory serendipitous research, not having any idea of what we will discover. Let's go back briefly to logic, both deductive and inductive. Beyond methods of inference, they also classify knowledge. Frequently, we hear of a person graduating from a technical institute as “educated”. Everyone goes to school to get an “education”, don't they? To answer “yes” to this question would be as absurd as saying closed is open or vice versa. Two words and their etymologies demonstrate why.

Formally stated, these are episteme and techne (Parry, 2014); the etymologies from Wikipedia are:

> "**Episteme**" is a philosophical term derived from the Ancient Greek word ἐπιστήμη *epistēmē*, which can refer to knowledge, science or understanding, and which comes from the verb ἐπίστασθαι, meaning "to know, to understand, or to be acquainted with".[1]
> Techné
> "**Techne**" is a term, etymologically derived from the Greek word τέχνη (Ancient Greek: [tékʰnɛː], Modern Greek: [ˈtexni] (listen)), that is often translated as "craftsmanship", "craft", or "art".

Let us view some dichotomies:

- theory – practice
- science – technology
- synthesis – analysis
- education – training
- abstract – concrete
- unknown – known
- Why - how
- chaos (inchoate) – entropy.

Deduction →
Induction ←

The left term refers to “episteme”; the right term describes “techne”. Each of these exists because of the other, the unity of opposites, or dialectics. There is no particular boundary line, the words demarcating the tendencies, or extremes, the right-hand arrow towards Cartesian analytics (deduction) and the left towards less detail and assembly of parts to yield a whole (induction - synthesis).
Now, let's bring in the logic once again. If you look at the left-hand, you'll notice conceptually it contains the right-hand. The right-hand can be deduced from the left-hand, making the first inductive in character, then right deductive. Induction is extrapolating by samples from the whole, or synthesis. Deduction works with what is known. If you know the abstraction, you can apply it. If you know why something works, you should be able to figure out how. Theory translates itself into practice.

Knowledge can be of either category. It may be probing why the law of gravity or an atom came to be – episteme. Techne focuses on the mechanical law and describing the inside of an atom. It may be an explanation of why persons act in a certain way - episteme. Knowledge may be how to use a computerized axial tomography (CAT) scanning machine - techne. While the techne refers to the “how”, students often may not know the destination of their endeavors. Too often our teachers and professors don't say the reason they should be going there, the episteme. It is like getting instructions from a parent to drive to the store to get a quart of juice never knowing why. So much of logic, science, and mathematics are taught from a techne perspective. You teach the students as you do dogs. An incorrect answer on an “objective” test merits a slap on the wrist, often being Pavlovian. Think of object-oriented destinations having limited purpose versus

goal-oriented ones with vision. Where do we go in space? Answer: assuming it is limitless, it is any distance and place (space-time) we want. Remember the circle part from the etymology of "research". A circle does not have to be closed. It also can be a spiral, a circle in the making in three or more dimensions.

I have identified three basic steps of university education: survey, research, and creation. In the undergraduate programme, a student learns obtains a knowledge of diverse subjects to fulfill requirements of the degree and focuses of what is entailed by her/his field of interest. The first-year student usually becomes acquainted with what is known, or facts. It is more techne than episteme. As s/he progresses, more of the unknown is encountered, and it becomes necessary to fill in more gaps with induction. Here, the student learns how to research, though not learning any real philosophy, as presented in this essay. ☻ Finally, the doctoral student gathers all s/he knows and engages in pure synthesis, "contributing to the body of knowledge". When a student graduates, s/he learns (or should) every day is a day in school, the only dividing line the formal school structure. Again, the overall lesson is learning is lifelong.

6.4. When to stop research

Should you create knowledge? There is knowledge for knowledge's sake. Another focus is the "ecology of knowledge", stemming from the cost to generate it, knowledge "pollution" (too much information"), and its utility and effectiveness. Ethics is a branch of philosophy, hence germane to the title of this essay, "The philosophy of research". What are we uncovering, why are we doing so, for whom are we doing the research, and so forth?

You need to dig deep within yourself to find your core values, valuing truth above all else, having a sense of right and wrong about what to do with it. Robert J. Oppenheimer and I am sure others agonized about developing the atomic bomb, and only a zombie, evil person, sociopath, or automaton would not recoil in horror over the loss of life and devastation wreaked on Hiroshima and Nagasaki. Should you develop that doomsday weapon? How about cloning? Geo-engineering – is that really a good idea to apply? Just because you are able to create does not imply the desirability to do so. These words are not new. In mild situations involving Moroccan tsetse flies, I ask how better time and resources could be used in generating practicality, rather than cleverness. For hardcore serious research, ask "should I really be doing this?"

A final thought is in order. You may have done diligence in trying to ascertain if your idea is really unique. What if it turns out that others have done the same or similar research? Have all your efforts been for naught? Absolutely not (pun intended). Think of what you have done as an independent confirmation of something that someone else has made a great effort to find out. This is similar to independent confirmation of a scientific finding, as in replicating an experiment. I would argue that independent discovery may be more powerful, as all the background research and thinking leading up to it have been done independently, pointing to the findings as standing apart from individuals, possibly being "innate" in our environment. Logic and math (not their language) I think are discoveries, rather than creations.

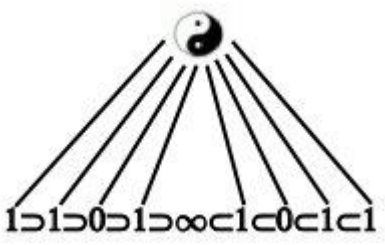
7. Conclusions

The capacity to research is equivalent to how far you can subdivide anything or expand it, from the infinitesimal to the infinite. Only a matter of judgement stands in the way. How much research is needed to "know" anything depends upon what the subject's scope is and how deep you want to make a Cartesian cut or go in space. Like the spiders, we are spinning our own webs of purported knowledge. I said above to be wary of the spider in the research web. We meet the spider and s/he is us.

Limitless or "final" statements have little substance without identifying the standards by which knowledge comes (epistemology) or why research is progressing. While each of us cannot escape our own bias, perforce "contaminating" every aspect of research and its presentation, the love of truth, meaning all sides have a say, is the guiding light to help eschew prejudice. We are embedded literally in a dimension; the least we can do is making our bed with tolerable integrity so we can lie down in it.

Epistemic research, the search for knowledge, is oriented to seeking truth and meaning, who we are, and why we are here in the Universe. Techne-oriented research is focused on application, how the theory developed with epistemic research may yield utility. The former is the subject of education, the latter training. Yet, synthesis emerges when one occurs because of the other, a unity of opposites, or dialectics.

The philosophy of research is philosophy – the perfect circle, answers producing questions, those questions in-turn producing more answers. Only two dimensions are involved with the circle. I hope we aspire to the spiral and beyond – perhaps "aspiral" – a new word for our language web.



Figue 11. A koan for you; don't devour it all at once (image by Horne)

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