

*...let my body dwell in poverty, and my hands be as the hands of the toiler; but let my soul be as a temple of remembrance where the treasures of knowledge enter and the inner sanctuary is hope...*

*It seems to me we can never give up longing and wishing while we are thoroughly alive. There are certain things we feel to be beautiful and good, and we must hunger after them...*

— GEORGE ELIOT

# The Nature and Functions of **CRITICAL & CREATIVE THINKING**



By DR. RICHARD PAUL and DR. LINDA ELDER

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# PART I

## The Very Idea of Critical and Creative Thinking

### The Inseparability of Critical and Creative Thought

*The critical and creative functions of the mind are so interwoven that neither can be separated from the other without an essential loss to both.*

— Anonymous

**Criticality assesses; creativity originates.**

For several reasons the relationship between criticality and creativity is commonly misunderstood. One reason is cultural, resulting largely from the mass media's portrayal of creative and critical persons. The media frequently represent the creative person as a cousin to the nutty professor, highly imaginative, spontaneous, emotional, a source of off-beat ideas, but often out of touch with everyday reality. The critical person, in turn, is wrongly represented as given to fault-finding, as skeptical, negative, captious, severe, and hypercritical; as focused on trivial faults, either unduly exacting or perversely hard to please; lacking in spontaneity, imagination, and emotion.

These cultural stereotypes are not validated by precise use of the words critical and creative. For example, in *Webster's Dictionary of Synonyms*, the word "critical,"

when applied to persons who judge and to their judgments, not only may, but in very precise use does, imply an effort to see a thing clearly and truly so that not only the good in it may be distinguished from the bad and the perfect from the imperfect, but also that it as a whole may be fairly judged and valued.

In *Webster's New World Dictionary*, the word "creative" has three interrelated meanings:

1) creating or able to create, 2) having or showing imagination and artistic or intellectual inventiveness (creative writing), and 3) stimulating the imagination and inventive powers.

Accordingly, **critical** and **creative** thought are both achievements of thought. Creativity masters a process of making or producing, criticality a process of assessing or judging. The very definition of the word “creative” implies a critical component (e.g., “having or showing imagination and artistic or intellectual inventiveness”). When engaged in high-quality thought, the mind must simultaneously produce and assess, both generate and judge the products it fabricates. In short, sound thinking requires both imagination and intellectual standards.

Throughout this guide we elaborate on the essential idea that intellectual discipline and rigor are at home with originality and productivity, and also that these supposed poles of thinking (critical and creative thought) are inseparable aspects of excellence of thought. Whether we are dealing with the most mundane intellectual acts of the mind or those of the most imaginative artist or thinker, the creative and the critical are interwoven. It is the nature of the mind to create thoughts, though the quality of that creation varies enormously from person to person, as well as from thought to thought. Achieving quality requires standards of quality — and hence, criticality.

In this guide, then, we explore the interdependence of criticality and creativity, exemplifying this interdependence at the most complex level of thought (that of genius) as well as the simplest level of thought (that of making sense of ordinary objects in everyday experience).

We also explore a corollary theme: that all creation of meaning tends toward systems of meanings rather than existing in the mind as unconnected atomic particles. This is integral to the nature of thought itself. The construction of any meaning assumes other meanings and implies yet further meanings (which in turn imply still further meanings). When attempting to understand any meaning, humans naturally seek to place it in a cluster of meanings, however partial their understanding might be. When they attempt to understand an idea as a thing unto itself, it doesn't take root in the mind. It doesn't connect to the systems of meanings within the mind. In short, for humans to think well, we must think within systems. We must create systems of meaning and assess our creations for accuracy, relevance, and adequacy. More on this point later.

Let's begin with some fundamentals. First, **all thinking is not of the same quality**. High-quality thinking is thinking that does the job set for it. It is thinking that accomplishes the purposes of thinking. If thinking lacks a purpose — if it is aimless — it may chance upon something of value to the thinker. But more often it will simply wander into an endless stream of unanalyzed associations from

one's unanalyzed past: "Hotdogs remind me of ballgames, ballgames remind me of Chicago, Chicago of my old neighborhood, my old neighborhood of my grandmother, of her pies, of having to eat what I didn't like, which reminds me... which reminds me... which reminds me..." Few people need training in aimless thinking such as this, or in daydreaming or fantasizing. For the most part, we are naturals at aimless thinking. We are inherently proficient at daydreaming and fantasizing.

However, we often have trouble in purposeful thinking, especially purposeful thinking that requires posing problems and reasoning through intricacies. Purposeful thinking requires both critical and creative thinking. Both are intimately connected to figuring things out. There is a natural marriage between them. Indeed, all truly excellent thinking combines these two dimensions. Whenever our thinking excels, it excels because we succeed in designing or engendering, fashioning or originating, creating or producing results and outcomes appropriate to our ends in thinking. It has, in a word, a creative dimension.

To achieve any challenging end, though, we also must have criteria: gauges, measures, models, principles, standards, or tests to use in judging whether we are approaching that end. What's more, we must apply our criteria in a way that is discerning, discriminating, exacting, and judicious. We must continually monitor and assess how our thinking is going, whether it is on the right track, whether it is sufficiently clear, accurate, precise, consistent, relevant, deep, or broad for our purposes.

We don't achieve excellence in thinking with no end in view. We design for a reason. We fashion and create knowing what we are trying to fashion and create. We originate and produce with a sense of why we are doing so. Thinking that is random, that roams aimlessly through half-formed images, that meanders without an organizing goal, is neither creative nor critical.

This is true because when the mind thinks aimlessly, its energy and drive are typically low, its tendency is generally inert, its results usually barren. What is aimless is also normally pointless and moves in familiar alliance with indolence and dormancy. But when thinking takes on a challenging task, the mind must come alive, ready itself for intellectual labor, engage the intellect in some form of work upon some intellectual object — until such time as it succeeds in originating, formulating, designing, engendering, creating, or producing what is necessary for the achievement of its goal. Intellectual work is essential to creating intellectual products, and that work, that production, presupposes *intellectual standards* judiciously applied. When this happens, creativity and criticality are interwoven into one seamless fabric.

Like the body, the mind has its own form of *fitness* or excellence. Like the body, that fitness is caused by and reflected in activities performed in accordance with standards (criticality). A fit mind can engage successfully in designing, fashioning, formulating, originating, or producing intellectual products worthy of its challenging ends. To achieve this fitness, the mind must learn to take charge of itself, energize itself, press forward when difficulties emerge, proceed slowly and methodically when meticulousness is necessary, immerse itself in a task, become attentive, reflective, and engrossed, circle back on a train of thought, recheck to ensure that it has been thorough, accurate, exact, and deep.

Its *generative power* (creativity) and its *judiciousness* (criticality) can be separated only artificially. In the process of actual thought, they are one. Such thought is systematic — when being systematic serves its end. It also can cast system aside and ransack its intuitions for a lead — when no clear maneuver, plan, strategy, or tactic comes to mind. And the generative, the productive, the creative mind has standards for what it generates and produces. It is not a mind lacking judiciousness, discernment, and judgment. It is not a mind incapable of acuteness and exactness. It is not a mind whose standards are vagueness, imprecision, inaccuracy, irrelevance, triviality, inconsistency, superficiality, and narrowness. The fit mind generates and produces precisely because it has high standards for itself, because it cares about how and what it creates.

Serious thinking originates in a commitment to grasp some truth, to get to the bottom of something, to make accurate sense of that about which it is thinking. This figuring out cannot simply be a matter of arbitrary creation or production. Specific restraints and requirements must be met, something outside the will to which the will must bend, some unyielding objectivity we must painstakingly take into account. This severe, inflexible, stern reality is exactly what forces intellectual criticality and productivity into one seamless whole. If there were no objectivity outside our process of figuring out, we would have literally nothing to figure out. If what we figure out can be anything we want it to be, anything we fantasize it as being, there would be no logic to the expression “figure out.”

In a sense, of course, all minds create and produce in a manner reflective of their fitness or lack thereof. Minds indifferent to standards and disciplined judgment tend to judge inexactly, inaccurately, inappropriately, prejudicially. Prejudices, hate, irrational jealousies and fears, stereotypes and misconceptions — these, too, are created, produced, originated by minds. Without minds to produce them, they would not exist. Yet they are not the products of creative minds. They reflect an undisciplined, uncritical mode of thinking and therefore are not properly thought of as products of creativity. In short, except in rare

**All thought involves systems of meanings. Thinking should assess what it creates.**

circumstances, creativity presupposes criticality, and criticality creativity. This essential insight is often missed or obscured.

At this point we will focus on the most important sense of creativity in thinking, the sense of thinking as a making, as a process of creating thought, as a process that brings thoughts into being to organize, shape, interpret, and make sense of the world — thinking that, once developed, enables us to achieve goals, accomplish purposes, solve problems, and settle important issues we face as humans in a world in which rapid change is becoming one of the few constants.

A mind that does not systematically and effectively embody intellectual criteria and standards is not disciplined in reasoning things through. Such a mind is not creative. There is, in other words, a reciprocal logic to both intellectual creation and critical judgment. There is an intimate interrelation between the intellectual *making* of things and the ongoing *critique* of that making. Let us examine this reciprocal logic more closely, through some examples.

Painters alternate the application of small amounts of paint to a canvas with the act of stepping back to appraise or assess their work. There are hundreds of acts of assessment that accompany hundreds of brush strokes. In a parallel fashion dancers use mirrors in the studio to observe their dancing while they are dancing. They use what they see in the mirrors as data to assess their performance. They engage in hundreds of acts of assessment in the light of images their minds form as they dance. They practice with a conception in their minds of what they are striving to create. They then assess the gap between the conception they are aiming at and the performance they see. They both create and assess their dancing. Let us now generalize this principle to all thinking as such.

## Thinking That Grasps the Logic of Things

To be intellectually assessed and validated, all intellectual products require some logic, some order or coherence, some intellectual structure that makes sense and is rationally defensible. This is true whether one is talking of poems or essays, paintings or choreographed dances, histories or anthropological reports, experiments or scientific theories, philosophies or psychologies, accounts of

specific events or those of general phenomena or laws.

A product of intellectual work that makes no sense, that cannot be rationally analyzed and assessed, that cannot be incorporated into other intellectual work, or used — and hence that cannot play a role in any academic tradition or discipline — is unintelligible. Whether we are designing a new screwdriver, figuring out how to deal with our children's misbehavior, or working out a perspective on religion, we must order our ideas into a system of meanings that make sense to us, a system of meanings with a coherent logic (which we both create and assess).

## Reasoning As a Creative Act

In the broad sense, all thinking is thinking within a system, and when we have not yet learned a given system — for example, not yet learned the logic of the internal combustion engine, the logic of right triangles, or the logic of dolphin behavior — our minds must bring that system into being, create it in the fabric, within the structure, of our established ways of thinking. Hence, when we are thinking something through for the first time, to some extent we are creating the logic we are using. We are bringing into being new articulations of our purposes and of our reasons. We are making new assumptions. We are forming new concepts. We are asking new questions. We are making new inferences. We are working out our point of view in a direction entirely new to us.

Indeed, there is a sense in which all reasoned thinking, all genuine acts of figuring out anything whatsoever, even something previously figured out, is a new *making*, a new series of creative acts, for we rarely recall our previous thought whole cloth. Instead, we remember only some part of what we figured out and we figure out the rest anew (based on the logic of that part and other logical structures more immediately available to us). Or we modify our existing ideas by accommodating what we believe to new information we learn. We continually create new understandings and re-create old understandings through a similar process of figuring.

Think of the process by which an anthropologist, discovering just one bone from an animal, is able to deduce, and thus create, the other bones and the rest of the body of the animal in question. The human mind continually uses some meanings to create others. Meanings, like living things, are found in systems. They do not stand alone in the mind. They are not like marbles in a bag, each

**Every genuine act of figuring out anything is a new making, a new series of creative acts.**

marble independent of all the others. They are like bodily systems — the digestive system, the nervous system, the respiratory system, and so forth. They work together in relation to each other.

To understand the intimate interplay between creative and critical thinking, between the thinking that creates a set of logically interrelated meanings and the thinking that assesses the logic being created, we need to understand, at least in part, how the mind creates meaning.

Whenever we are trying to figure something out, at least three systems are involved:

1. The logic to be figured out (the system we are trying to understand or create in our minds)
2. The logic we use to do the figuring (chosen by us from the systems we have already learned or created in our minds)
3. The logic that results, in the end, from our reasoning — and that has to be assessed for its fit, for the extent to which it has captured the system (1) to be figured out.

One may use, for example, one's understanding of the major themes in a D.H. Lawrence novel (say, *Sons and Lovers*) as an initial framework for understanding the themes of another (say, *Lady Chatterley's Lover*). The resulting understanding may or may not make sense of the actual story. The logic one forges may be inadequate. Or, again, in studying history, one may use one's understanding of the logic behind an economic crisis (say, that of the 1930s in the USA) to understand the logic behind another economic crisis (say, that of the 1990s in the USA). The mental reconstruction one creates may or may not make sense of the logic of what was actually going on economically in the 1990s. In all our learning, we mentally create provisional models (small-scale logical systems) for figuring out what we are trying to learn (the system we are trying to grasp). We then end up with a product of thought, a system we have created. That system may or may not match reality.



## Creative Genius — An Exception?

Some might object to the line of reasoning we have laid out thus far. They might say that the intimate interconnection of critical thinking and creative thinking does not hold for truly creative geniuses. They might argue that creative genius emerges spontaneously and mysteriously, that it is linked to unconscious processes that defy rational explanation, processes that go beyond critical thinking and rational thought. As cases in point, they might cite the work of great artists, inventors, and thinkers such as Leonardo Da Vinci, Rembrandt, Michelangelo, Mozart, Beethoven, Wagner, Edison, Shakespeare, Einstein, Newton, and Darwin.

**History teaches us that great minds require cultivation and committed intellectual work.**

To think-through the relationship between creative genius and critical thought and respond to these objections, let us consider the following questions:

- To what extent is the capacity for creative genius realized in a purely untutored state?
- To what extent must genius be cultivated through the development of critical thought?

We will briefly approach these questions first conceptually, and then historically.

## Language as a Guide

Let us look, first at how language sheds light on genius and related concepts.

The *Oxford English Dictionary* defines genius in two ways:

1. As having “natural aptitude, ability or capacity; quality of mind; the special endowments which fit a man for his peculiar work.”
2. As “native intellectual power of an exalted type, such as is attributed to those who are esteemed greatest in any department of art, speculation, or practice; instinctive creation, original thought, invention or discovery.”

The first definition comes close to what is typically meant by the term gifted, and it implies that the gift predisposes one to high-quality thought within a specialty. The second sense focuses on the successful use of intellectual processes, and primarily on creative production, which need not imply inborn talent.

To better understand the concept of *genius*, let us remind ourselves of its most basic meaning, as well as the meanings of some related concepts: talent, giftedness, aptitude, intelligence, brilliance, accomplishment, proficiency, and virtuosity. Consider the following definitions (and distinctions) found in *Webster's New World Dictionary*:

- **Talent:** implies an apparently native ability for a specific pursuit and connotes either that it is or can be cultivated (or left largely undeveloped) by the one possessing it.
- **Gifted:** suggests that a special ability is bestowed upon one, as by nature, and not acquired through effort.
- **Aptitude:** implies a natural inclination for a particular work, specifically as pointing to a special fitness for or probable success in it.
- **Genius:** implies an inborn mental endowment, specifically of a creative or inventive kind in the arts or sciences, or that is exceptional or phenomenal.
- **Intelligent:** implies the ability to learn or understand from experience or to respond successfully to a new experience.
- **Brilliant:** implies an unusually high degree of intelligence.
- **Accomplished:** skilled, proficient.
- **Proficient:** highly competent, skilled, adept.
- **Virtuoso:** a person displaying great technical skill in some fine art, especially in the performance of music.

Notice that talent, gift, genius, and aptitude all imply an inborn disposition to excel within some domain of thought. But intelligence, brilliance, accomplishment, proficiency, and virtuosity need not presuppose innate tendencies. Assuming that these distinctions mirror important qualities in human development, a real possibility is suggested: A person may be highly creative, even brilliant, without having a high degree of innate talent. This possibility is borne out by empirical fact. Many highly accomplished thinkers, rightly considered geniuses, have displayed that brilliance only after investing years in perfecting potential not extraordinary to begin with.

**Genius is better understood in relation to talent, giftedness, aptitude, capacity, ability, and intelligence.**

## The Narrow-Minded Genius

Before we elaborate this point, let us come to terms with the fact that genius can exist in a highly circumscribed form. At one and the same time, a person can combine “genius” (in one domain of life) with narrowness and parochialism (in all of the others). For example, many brilliant thinkers enthusiastically served in the Nazi regime. The brilliant rocket scientist Werner Von Braun was one such person. The German generals Rommel and Guderian were two others. Within their specialties they functioned at the very highest levels, yet their ethical reasoning abilities and world perspective were sadly impoverished. One-dimensionality is possible in the life of a genius, as in anyone else. Individuals can perform at what appears to be genius level in one domain while thinking superficially in most other domains of their lives.

**Genius is often specialized, limited to particular intellectual domains.**

Consider the case of Michael Kearney.<sup>1</sup> Kearney graduated from high school at the age of 6, graduated from a junior college at age 8, and completed a bachelor's degree at age 10. Kearney, who earned a master's degree in microbiology at age 14, is at the time of this writing (age 19) working toward a doctorate.

He works as an intern at Microsoft Corporation. According to a newspaper article, Kearney, who is dating a 22-year-old English major, said, “The good thing is we never need to have intellectual debates because I know nothing about Jane Austen.” Kearney also said he hasn't given up his dream — to be a TV game-show host. With all his intellect, he'd like nothing better than to fill in for Bob Barker if he retires from “The Price Is Right.” “In the back of my head, Hollywood is always calling,” said Kearney, who has appeared on talk shows and did a pilot for a talk show. But Kearny hasn't ruled out the possibility of a teaching career or a permanent job with Microsoft, which he said is “pretty cool.”

Clearly, Kearny is a person endowed with inborn intellectual gifts that few could boast. Yet what a waste that a genius — or potential genius, if you will — finds satisfaction in the fact that he knows nothing about Jane Austen and aspires, as his highest goal, to become a Hollywood game-show host.

1 The Santa Rosa Press Democrat, August 11, 2003.

This is just one of the many examples illuminating the fact that, without development of critical capacities, raw inborn talent is easily wasted or misused. The cultivation of innate gifts must be joined with critical thinking skills and abilities if one is to achieve results worthy of high praise.

## The Interplay Among Inborn Gifts, Environment, and Self-Motivation

What, then, distinguishes those who excel at creative thought from those who don't? Our analysis implies that outstanding creative work ultimately emerges from application involving both criticality and originality. We concede the obvious: a minimal level of inborn capacity is necessary for high achievement. But one might well become an eminent thinker without inborn genius or extraordinary gifts if moderate raw capacity is joined with intellectual perseverance, intellectual stimulation, and intellectual discipline.

To be more precise, three conditions contribute to a high level of creative thought:

1. A minimal level of innate intellectual capacity (though it need not be extraordinary).
2. An environment that stimulates the development of that capacity.
3. A positive response and inner motivation on the part of the person thus born and situated.

**External support and internal motivation are required to foster innate capacity.**

We will now support this view with anecdotal evidence that we believe is representative of the role that intellectual discipline, external support, and internal commitment typically play in the development of great thinkers, artists, dancers, and composers. In each case, notice how much attention, tutoring, dedication, and special training each of these thinkers had. Clearly, in the geniuses that we focus on here, much more was involved in their success than innate capacity per se.

## Aristotle

According to the *Encyclopedia Britannica* (Eleventh Edition, 1910),

Aristotle from the first profited by having a father who, being physician to Amyntas II, king of Macedon, and one of the Asclepiads who, according to Galen, practiced their sons in dissection, both prepared the way for his son's influence at the Macedonian court, and gave him a bias to medicine and biology, which certainly led to his belief in nature and natural science, and perhaps induced him to practice medicine. . . . At Athens in his second period for some twenty years he acquired the further advantage of balancing natural science by metaphysics and morals in the course of reading Plato's writings and of hearing Plato's written dogmas. He was an earnest, appreciative, independent student. . . . In his library [Aristotle was] constantly referring to his autograph rolls; entering references and cross-references; correcting, rewriting, collecting and arranging them according to their subjects; showing as well as reading them to his pupils, but with his whole soul concentrated on being and truth (p. 501).

According to Adler,<sup>2</sup>

Aristotle studied under Plato for 20 years, evolving from a “gifted student to a leading philosopher probing the nature of reality, knowledge, logic and causality. . . . Aristotle eventually—after the age of 50— produced a series of books that form the foundation of biology. . . . He spent years patiently observing, studying, and dissecting animals. In all he described nearly 600 species. . . . over the course of many years, he compiled similarities and differences, noted signs of close or distant relationships and tried to make out nature's own groupings. . . . {he offered} himself as the model — the first and one of the best — of a naturalist at work. He created biology as a science, asked profound questions, and showed that those questions could be answered, but only through patient and painstaking dialogue with nature itself (pp. 22-24).

## Ludwig Van Beethoven

As detailed in the the *Encyclopedia Americana*, 1950 edition, The Dutch “van” in Beethoven's name indicates:

his descent from a family in the Netherlands, the world's musical center in the 15th and 16th centuries. . . . Beethoven's grandfather was a bass singer and a conductor; his father was a tenor. . . . He personally taught Beethoven

<sup>2</sup> *Science Firsts: From the Creation of Science to the Science of Creation*, by R. Adler (Hoboken, NJ: John Wiley & Sons, 2002).

to play the violin and the clavier. A sketchbook was always in [Beethoven's] pocket, and into this he jotted his ideas as they came. Afterward he revised and re-revised these sketches. There is hardly a bar in his music of which it may not be said with confidence that it has been rewritten a dozen times. Of the air 'O Hoffnung' in 'Fidelio,' the sketch book shows 18 attempts, and of the concluding chorus 10. These sketches...give an interesting and instructive insight into the workshop of genius (p. 436-437).

## Marie Curie

In 1897, Marie Curie began her doctoral research, focusing on a new type of ray existing in uranium. According to Adler,<sup>3</sup>

From the start, her work was precise, systematic, and insightful... With her typical determination, Marie set out to prove the existence of the new element or elements...she repeatedly dissolved and re-crystallized the solutions. Over time, and with great effort, she was able to extract minute quantities of two new, intensely radioactive elements... It meant three years of exhausting labor in an unheated warehouse, stirring huge vats of boiling chemicals with a heavy iron paddle—then painstakingly crystallizing and re-crystallizing the solutions. 'I would be broken with fatigue at the day's end,' she said... Marie Curie...kept her place in the forefront of the field. Marie became the first woman to receive the Nobel Prize (pp. 108-109).

## Leonardo Da Vinci

According to *Funk and Wagnall's New Encyclopedia* (1986), Da Vinci was

"the son of a wealthy Florentine notary and a peasant woman. In the mid 1460s the family settled in Florence, where Leonardo was given the best education that Florence, the intellectual and artistic center of Italy, could offer." At the age of 16, Leonardo "was apprenticed as a garzone (studio boy) to Andrea del Verrocchio, the leading Florentine painter and sculptor of his day." As a scientist, Leonardo "understood better than anyone of his century or the next, the importance of precise scientific observation... In anatomy he studied the circulation of the blood and action of the eye. He made discoveries in meteorology and geology, learned the effect of the moon on the tides, foreshadowed modern conceptions of continent formations, and surmised the nature of fossil fuel... (p. 65)." These abilities were clearly developed through systematic and disciplined study.

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3 *ibid.*

## Galileo

According to the *Encyclopedia Americana* (1950),

Galileo's father was an impoverished nobleman of Florence, caused him to be instructed in Latin and Greek, drawing and music... In 1581 Galileo entered the University of Pisa, to attend lectures on medicine and the Aristotelian philosophy. Here he became conspicuous in refusing to accept without question the dogmatic statements of his teachers (pp. 237-238).

According to Adler, in 1609, Galileo

broke through the boundaries of what was known and believed by fashioning a simple telescope and turning it to the skies... Galileo set out to prove or disprove competing theories not just through logic but through experimentation... {He} painstakingly timed balls rolling down inclined planes... With the zeal of a bloodhound hot on a trail, Galileo pushed on with his telescopic observations. By the fall of 1610 he had made close to 100 telescopes... Galileo was the first to carry out real-world experiments — dropping and rolling various weights... which founded the scientific study of motion and gravity (pp. 44-48).

## Michelangelo

According to *Funk and Wagnall's New Encyclopedia* (1986),

At the age of 13, Michelangelo was placed by his father in the workshop of the painter Domenico Ghirlandaio. After about two years, he went on to study at the sculpture school in the Medici gardens. In order to prepare to paint the Sistine Chapel ceiling, he drew numerous figure studies and cartoons, devising scores of figure types and poses (pp. 273-274).

The *Encyclopedia Britannica*: (Eleventh Edition, 1910), adds the following details about Michelangelo's life:

at thirteen he got himself articulated as a paid assistant in the workshop of the brothers Ghirlandaio. Domenico Ghirlandaio had become by this time the foremost painter of Florence. In his service the young Michelangelo laid the foundation of that skill in fresco with which twenty years afterwards he confounded his detractors in Rome. He studied also in the Brancacci chapel, where the frescoes of Masaccio, painted some sixty years before... For nearly all his great life-works preparatory sketches and studies by the master's hand exist. These, with a large number of other drawings, finished and unfinished, done for their own sakes and not for any ulterior use, are of infinite value and interest to the student. Michelangelo was the most learned

and scientific as well as the most inspired and daring of draughtsmen, and from boyhood to extreme old age never ceased to practice with pen, chalk or pencil... Michelangelo's poetic style is strenuous and concentrated like the man. He wrote with labour and much self-correction; we seem to feel him flinging himself on the material of language with the same overwhelming energy and vehemence with which contemporaries describe him as flinging himself on the material of marble — the same impetuosity of temperament combined with the same fierce desire of perfection (pp. 362-368).

## The Questioning Minds of Newton, Darwin, and Einstein

**Newton, Darwin, and Einstein exemplify the importance of questioning and commitment in developing genius.**

Let's take a closer look at the thinking of three of the greatest minds in science history: Newton, Darwin, and Einstein. What Newton, Darwin, and Einstein had in common was not some set of inexplicable or esoteric qualities but, rather, down-to-earth excellence in the art of questioning and an uncommon doggedness in pursuing deep answers to the questions they raised. A close examination of their intellectual development does not suggest mystery but, instead, the importance of focusing on what is fundamental

and significant in a subject. Through skilled deep and persistent questioning, they redesigned our view of the physical world and the universe. The questions they raised and the manner in which they pursued these questions embodied the very essence of critical and creative thought.

### Isaac Newton<sup>4</sup>

Uninterested in the set curriculum at Cambridge, Newton at age 19 drew up a list of questions under 45 headings. His title, *Quaestiones*, signaled his goal: to constantly question the nature of matter, place, time, and motion. His style was distinctly non-esoteric: to slog his way to knowledge. For example, he “bought Descartes's *Geometry* and read it by himself. After two or three pages, when

<sup>4</sup> All quotes from *Newton: The Life of Isacc Newton*, by Richard Westfall (New York, NY: Cambridge University Press, 1993).



he could understand no farther, “he began again and advanced farther and continued doing so till he made himself master of the whole.”

When asked how he had discovered the law of universal gravitation, he said: “By thinking on it continually, I keep the subject constantly before me and wait till the first dawns open slowly, by little and little, into a full and clear light.” This pattern of consistent, almost relentless questioning, this combination of critical and creative thought, led to depth of understanding and reconstruction of previous theories about the universe.

Newton acutely recognized knowledge as a vast field to be discovered: “I don’t know what I may seem to the world, but, as to myself, I seem to have been only like a boy playing on the sea shore, and diverting myself in now and then finding a smoother pebble or prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.”

## Charles Darwin<sup>5</sup>

Like Newton and Einstein, Darwin had a careful mind rather than a quick one: “I have as much difficulty as ever in expressing myself clearly and concisely; and this difficulty has caused me a very great loss of time, but it has had the compensating advantage of forcing me to think long and intently about every sentence, and thus I have been led to see errors in reasoning and in my own observations or those of other.”

In pursuing intellectual questions, Darwin relied upon perseverance and continual reflection, rather than memory and quick reflexes. “I have never been able to remember for more than a few days a single date or line of poetry.” Instead, he had “the patience to reflect or ponder for any number of years over any unexplained problem. . . . At no time am I a quick thinker or writer: whatever I have done in science has solely been by long pondering, patience, and industry”.

## Albert Einstein<sup>6</sup>

For his part, Einstein, did so poorly in school that when his father asked his son’s headmaster what profession his son should adopt, the answer was simply, “It doesn’t matter; he’ll never make a success of anything.” In high school, the

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5 Quotes from *The Autobiography of Charles Darwin*, ed. by Francis Darwin (New York, NY: Dover Publications, 1958).

6 Quotes taken from *A. Einstein: The Life and Times*, by Ronald Clark (New York, NY: Avon Books, 1984); and *A Variety of Men*, by C.P. Snow (New York, NY: Charles Scribners and Sons, 1967).

regimentation “created in him a deep suspicion of authority. This feeling lasted all his life, without qualification.”

Einstein showed no signs of being a genius, and as an adult denied that his mind was extraordinary: “I have no particular talent. I am merely extremely inquisitive.” He failed his entrance examination to the Zurich Polytechnic. When he finally passed, the examinations so constrained his mind that, when he had graduated, he did not want to think about scientific problems for a year. His final exam was so nondistinguished that afterward he was refused a post as an assistant (the lowest grade of postgraduate job). Exam-taking, then, was not his forte. Thinking critically and creatively were.

Einstein had the basic critical thinking ability to cut problems down to size: “One of his greatest intellectual gifts, in small matters as well as great, was to strip off the irrelevant frills from a problem.”

When we consider the work of these three thinkers, Newton, Darwin, and Einstein, we find not the unfathomable, genius mind but, rather, thinkers who combined critical and creative thought in the passionate, but non-esoteric, pursuit of truth.

## Creativity — Not Mystified

A careful examination of the history of creative people, we believe, supports our central claim that critical and creative thought are intimately related. Each without the other is of limited use. Creativity without criticality is mere novelty. Criticality without creativity is bare negativity. Native giftedness cannot be developed without some cultivation and environmental support. For example,

**Creativity  
is best  
understood  
in simple  
everyday  
thought.**

Einstein never could have become one of the world's greatest scientists had he been born to a sub-Saharan mother living in absolute poverty. Through cultivation and support, both judiciousness and originality must be encouraged — not to mention the intellectual courage and perseverance that enable persons of great talent to study and develop through many years of challenging intellectual work.

The material point here is that creativity should not be mystified. Much of what appears to be inexplicable can be explained — at least in large part — by mundane accounts. Even those born with extraordinary gifts need the corrective and expansive power

## PART II

# Critical/Creative Thinking and the Foundations of Meaningfulness

### Figuring Out the Logic of Things

As we said at the outset:

Creative thinking, especially, must be demystified and brought down to earth. For this reason, we deal with it in terms of its highest manifestation in the work of geniuses, and also in its most humble manifestations in ordinary run-of-the-mill perception and thought.

In learning new concepts, in making sense of our experience, in apprehending a new subject field or language, in reading, writing, speaking, and listening, our minds engage in full-fledged (though commonplace) creative acts. To understand how and why this is so, we need not appeal to the esoteric, the recondite, or the arcane.

In this spirit, let us discuss how the mind operates when figuring things out, how it creates meaning in its everyday functioning, and how that meaning must be assessed for quality.

To say that something is meaningful is to say that it can be understood by use of our reason, that we can form concepts that accurately — though not necessarily thoroughly — characterize the nature of that thing. Only when we have in some way conceptualized a thing can we reason through it.

Because nature does not provide us with innate ideas, we must create concepts, individually or socially. Once conceptualized, a thing is integrated by us into a network of ideas (because no concept can stand alone) and, as such, becomes the vehicle for many possible inferences.

For example, the way I conceptualize marriage guides the conclusions I come to about whether to marry a specific person, and then, later, whether I think my marriage is working, and whether, perhaps, I should seek to dissolve the marriage. Similarly, the way I conceptualize

**In thinking critically, we take command of the meanings we create.**

the process of learning guides the conclusions I come to about learning. For example, if I conceptualize learning as the memorizing of facts, and if I am skilled at memorization, I will conclude that I am a skilled learner. I will infer that anyone who is good at memorizing facts is bright, and those who are unskilled at memorizing facts are not. I will infer that the only thing one has to learn well is the skill of memorization. I therefore will misunderstand what learning entails. This misunderstanding is initiated in my erroneous conceptualization of learning.

Once we begin to make inferences about something, we can do so either well or poorly, justifiably or unjustifiably, in keeping with the meaning of the concept and the nature of what we know of the thing conceptualized, or not so in keeping. If we are not careful, we might (and very often do) infer, and thus create in our minds, more than is implied.

If I hear a sound at the door and conceptualize it as “scratching at the door,” I may infer that it is my dog wanting to come in. I have used my reason (my creative capacity to conceptualize and infer) to interpret the noise as a “scratch,” and I have assumed, in the process, that the only creature in the vicinity who could be making that scratch at my door is my dog. But my reasoning could be off. I might have misinterpreted the noise as a “scratch” (I may even have misheard where the noise was coming from) or I might have wrongly assumed that there were no other creatures around that might make that noise. Notice that in these acts I *create*, *originate*, or *bring into being* the conceptualizations at the root of my thinking.

We approach virtually everything in our experience as something that can be thus decoded by the power of our minds to create a conceptualization and to make inferences on the basis of it (hence to bring into being further conceptualizations). We do this so routinely and automatically that we typically don't recognize ourselves as engaged in processes of reasoned creation — the creations of the reasoning mind. In our everyday life we don't first experience the world in *concept-less* form and then deliberately place what we experience into categories so as to make sense of things.

Rather, it is as if things are given to us with their names inherent in them. Thus, we see trees, clouds, grass, roads, people, men, women, and so on. We apply these concepts intuitively, as if no rational, creative act were involved. Yet, if we think about it, we will realize that there was a time when we had to learn names for things and, hence, before we knew those names, we couldn't possibly have seen these phenomena through the mediation of these concepts.

In learning these concepts, we had to *create* them in our own minds out of the concepts we had already learned.

When we say “the logic of something,” we mean something basic and simple: *the system of meanings that makes sense of a thing*. Thus, you must understand certain essential meanings before you can make sense of, for example, how a bicycle operates. When you understand the system behind it, and can explain that system, you then grasp the logic of how a bicycle functions. You might, of course, be able to ride a bicycle, but not understand how it operates.

For example, we study living organisms to construct *bio-logic* (biology) — that is, to establish ways to conceptualize and make valid inferences about life forms. We study social arrangements to construct *socio-logic* (sociology) — that is, to establish ways to conceptualize and make valid inferences about life in society. We study the historical past to construct the logic of history, ways to conceptualize and make valid inferences about the past. Because no one is born with these conceptual structures at his or her command, everyone must create them. Thus, all humans are creative merely because we are living a human life and, hence, inevitably figuring things out as we go.

In thinking critically, we take command of our conceptual creations, assessing them far more explicitly than is normally done. Concepts, like all human creations, can be well or poorly designed. Critical judgment (discernment, being judicious) is always relevant to the process of design and construction, whether that construction be conceptual or material.

In the remainder of this guide, we explore the two interrelated phases of critical thinking: producing (creating) and assessing (critiquing) systems of meaning. We focus explicitly on:

- Concepts and language
- Human thinking
- Academic disciplines
- Questions
- Reading, writing, speaking, and listening

## Learning Concepts and Language

In this guide we are using the word *concept* to mean simply a group of things resembling each other in a describable way. We understand conceptualization to be a process by which the mind infers a thing to be of a certain kind, to belong properly to some given class of things. Hence, if I describe someone as clever, I have placed the person into a generalized group of people (those who are quick-witted).

Our minds understand things in terms of how they relate to what we believe to be true. We interpret the world by putting objects into categories or concepts, each of which highlights some set of similarities or differences. We then link the thing with other concepts, in the process validating a certain set of inferences.

For example, if I see a creature before me and take it to be a dog, I can reasonably infer that it will bark rather than meow or purr. Furthermore, by placing it into the concept of dog, I create a family of meanings by means of other concepts interrelated with that of dog, such as animal, furry, muzzle, paw, tail, and so forth.

In learning to speak our native language, we necessarily learn thousands of concepts that, when properly used, enable us to make countless legitimate inferences about the objects of our experience. Unfortunately, nothing in the way we ordinarily learn to speak a language forces us to use concepts carefully, or prevents us from making unjustifiable inferences while engaged in their use. The mind that creates meanings can create them well or poorly. Indeed, a fundamental need for critical thinking is given by the fact that as long as the mind remains undisciplined in its use of concepts, it is susceptible to any number of illegitimate inferences created by egocentric or undisciplined mental acts.

The process of learning the concepts implicit in a natural language such as English is a process of creating facsimiles (in our minds) of the concepts implicit in the language usage to which we are exposed. But we cannot “give” anyone the meaning of a word or phrase; that meaning must be created individually by every person who learns it. We can give a person a dictionary-definition of a word, but that definition must be interpreted and, in effect, paraphrased in the mind to gain initial ownership of it. When we misinterpret

**To learn concepts and use language, we must create them through mental acts.**

a definition, we mis-learn the meaning of the word in question. Thus, we create in our minds a meaning that conflicts with the established meaning of the word.

To take command of our thinking, critically and creatively, requires that we take command of the language we use. Many of our ideas or concepts come from the languages we have learned to speak, and in which we do our thinking. Embedded in the educated use of words are criteria or standards we must respect before we can think clearly and precisely by means of those words. We are free, of course, to use a given word in a special way in special circumstances, but only if we have good reason for modifying its established meaning.

Such special stipulations should proceed from a clear understanding of established educated use. We are not free, for example, to use the word “education” as if it were synonymous with the words “indoctrination,” “socialization,” or “training.” We are not free to equate pride with cunning, truth with belief, knowledge with information, arrogance with self-confidence, desire with love, and so on. Each word has its own established logic, a logic that cannot, without confusion or error, be ignored.

Each word has a home in at least one established system of meanings. To learn the meaning of any one word in a system of words, we have to learn something of the other (interwoven) meanings. We have to re-create that system in our thinking, and we must base that creation on meanings we have created previously. Learning the meaning of a word is not a simple task, because in each case we must create a new concept in our minds out of modified old understandings. This requires that our creation be ordered, restrained, regulated, and controlled. Words do not mean anything we want them to mean. We must construct meanings in our minds that are accurate — given established educated usage. As always, thinking that calls for assessment (criticality) works hand-in-glove with thinking requiring creative production.

## **Critiquing Human Thinking**

In a literal sense there is no virtue in merely creating meaning. Prejudices, self-delusions, distortions, misconceptions, and caricatures — all are products of the mind as maker and creator. Unfortunately, humans typically create thought that is vague, fragmented, contradictory, egocentric, sociocentric, and lacking in foundational insights. This is so because the natural state of the human mind is one of egocentrism. When functioning in such a state, we give

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**Dr. Richard Paul** was a leading proponent of critical thinking until his death in August of 2015, and in his work and legacy, Paul remains an international authority on critical thinking. He founded the Center for Critical Thinking at Sonoma State University in 1980, followed by the Foundation for Critical Thinking. In his lifetime, he developed concepts, principles, and theory essential to a robust and fairminded conception of critical thinking; he worked tenaciously to advance ethical, or strong-sense, critical thinking throughout education and society. In his lifetime, Paul authored more than 200 articles and seven books on critical thinking. He presented workshops to hundreds of thousands of educators over his 35-year history as a primary leader in the critical thinking movement.

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