



## Editorial

# Mental energy

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### Abstract

Biographies of great achievers, in science as well as other disciplines, suggest that those of genius caliber possess, in addition to their intellectual gift or gifts, an extraordinary abundance of mental energy. They can focus their attention on some task for long periods without tiring or becoming distracted from the problem at hand. It is plausible to suppose that intellectual achievement is a function of the product, rather than the sum, of mental talent and mental energy. It is therefore surprising that no standardized measure or method of assessing mental energy has been developed. One obvious approach would employ a variety of self-report items similar to those suggested. Perhaps other methods of assessing mental energy are feasible and might usefully augment current methods of predicting academic and occupational success.

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I have always thought it obvious that high intellectual achievement (e.g., genius) is a multiplicative function of talent times mental energy. Spearman (1927, p.411) actually proposed that general intelligence is equivalent to mental energy. But surely among persons with the same IQ there remains great variation in the ability to focus efficiently for extended periods on some appropriate mental task? It seems equally obvious that other contributors to effective performance, such as interest, ambition, and drive, become ineffectual once mental energy is exhausted. We have numerous measures of various intellectual talents, and of their common factor,  $g$ , but to my knowledge there has not been published a useful measure of mental energy. The purpose of this editorial is to challenge psychometrists younger than I am to repair this deficiency. Let me first state the proposition in its basic, unadorned form so that the reader can decide whether, as I claim, it is (not necessarily true) but obviously plausible.

Mental energy ( $e$ )-the ability to persist for long periods thinking productively about a problem, the ability to focus attention, to shut out distractions, to persist in search of a solution-is perhaps as important as general intelligence ( $g$ ) in determining both successful performance and constructive achievement and the product of these two variables,  $g*e$ , provides the most valid predictor of success and achievement.

## 1. Mental energy and genius

From Archimedes and Socrates, to Galileo and Newton, to Einstein and Richard Feynman, many (most?) scientific and mathematical geniuses have been, not only very clever, but also capable of total and protracted absorption by their thought processes. Archimedes's "awesome mathematical talent was augmented by an ability to devote himself single-mindedly to any problem at hand in extraordinary periods of intense, focused concentration. At such times, the more mundane concerns of life were simply ignored." (Dunham, 1990).

Isaac Newton, asked how he made his remarkable discoveries, replied: 'I keep the subject constantly before me and wait until the first dawns open little by little into the full light' (Andrade, 1956). He had "an almost voluptuous intellectual energy, one amounting to mania. Newton's day-to-day life was disorderly; he slept when sleep overpowered him. He read continually, he meditated without pause, often for days on end. He was often too distracted to eat." (Berlinski, 2000, p. 22). According to Keynes (1956), Newton's special gift was: "the power of holding continuously in his mind a purely mental problem until he had seen straight through it".

During 1915–17, Einstein; "working like a horse, smoking like a chimney, and living alone on a diet of coffee, cheap sausage and cookies, had finally completed the general theory of relativity, reinvented gravity, space, and time, and used relativity to reinvent the universe itself..arguably the most prodigious effort of sustained brilliance on the part of one man in the history of physics."(Overbye, 2000, pp. 36 and 327).

Richard Feynman's biographer, James Gleick (1992), describes a 1960s Caltech seminar at which astrophysicist Willy Fowler proposed that the recently discovered quasars were supermassive stars.

Feynman immediately rose, astonishingly, to say that such objects would be gravitationally unstable. Furthermore, he said that the instability followed from general relativity. The claim required a calculation of the subtle countervailing effects of stellar forces and relativistic gravity. Fowler thought he was talking through his hat. A colleague later discovered that Feynman had done a hundred pages of work on the problem years before. The Chicago astrophysicist Subrahmanyan Chandrasekhar independently produced Feynman's result-it was part of the work for which he won a Nobel Prize twenty years later. Feynman himself never bothered to publish. Someone with a new idea always risked finding, as one colleague said, "that Feynman had signed the guest book and already left".

The great Hindu mathematician, Srinivasa Ramanujan, whom Mark Kac called a 'magical genius' (Kolata, 1987), was reared in a one-room adobe hut in southern India and his mathematical education consisted primarily of two books, both in a foreign language (Borwein & Borwein, 1988). In 1913, with the help of a better-educated friend, Ramanujan wrote from Madras to the great G.H. Hardy at Cambridge, asking his opinion of some 120 theorems which were enclosed (Hardy, 1940, cited by Newman, 1956).

Having been greatly impressed by these theorems, Hardy invited Ramanujan to Cambridge and later told of a visit he made to Ramanujan "when he was lying ill at Putney. I had ridden in taxi-cab No. 1729, and remarked that the number seemed to me rather a dull one, and that I hoped it was not a bad omen. 'No,' he replied, 'it is a very interesting number; it is the smallest number expressible as a sum of two cubes in two different ways'" (Newman, 1956). It was said of Ramanujan that every number was his

friend and he had plainly thought about and stored away many interesting facts about most of the lower integers, no doubt by “thinking about them all the time”.

On reading Hereditary genius, by his cousin, Francis Galton, Charles Darwin wrote: “You have made a convert of an opponent in one sense, for I have always maintained that, excepting fools, men did not differ much in intellect, only in zeal and hard work; and I still think [this] is an eminently important difference.” Thomas Edison, too, believed that genius was ninety-nine per cent perspiration and one per cent inspiration and he “often work[ed] as many as 112 hours a week” (McAuliffe, 1995).

If we expand our definition of genius slightly to include statesmen, warriors, artists, musicians, authors, engineers, entrepreneurs, and other earth-movers (including “evil geniuses”) we find again that extraordinary mental energy seems to be an essential component of the recipe for outstanding accomplishment. William Gladstone received first honors from Oxford in both Classics and Mathematics and then went on, to Queen Victoria’s dismay, to be one of Britain’s most effective Prime Ministers. When not reforming the government, he is said to have read some 20,000 books, in five languages, while in his spare time he enjoyed chopping down trees (Jenkins, 1997).

Benjamin Franklin was prodigiously productive in diverse areas (e.g., Isaacson, 2003, p. 436). Even more remarkable, perhaps, was Franklin’s younger colleague, Alexander Hamilton, who immigrated from the West Indies at age 16 and, by age 34, had become a war hero, army general, admired attorney, and first Secretary of the Treasury (Chernow, 2004). “Hamilton was an exuberant genius who performed at a fiendish pace and must have produced the maximum number of words that a human being can scratch out in 49 years,” (ibid, p.5). His collected works amount to 22,000 pages!

Theodore Roosevelt’s father, Theodore Senior, was gifted “with magnificent health and strength—‘I never seem to get tired’” (Morris, 1979, p.4). Between his 21st and 22nd birthdays, Theodore Junior climbed the Matterhorn, attended Columbia Law School, wrote the definitive history of The Naval War of 1812 (!), and became a candidate for the New York State Assembly. Like both Roosevelts, Pablo Picasso had “inexhaustible vitality and, in his eighties, said ‘I never get tired.’” (Landrum, 1993, p.15).

Captain Horatio Nelson, later Vice-Admiral Lord Viscount Nelson, in the battle for Corsica in 1795, spent weeks supervising the landing of 3-ton cannons and tons of powder and shot, its haulage over miles of rough terrain, and the bombardment of enemy forts and cities. He was then age 35, only 5’6” tall and slightly built, but he had extraordinary energy, both mental and physical. His log for 9 September reads: “My constitution is absolutely the wonder of the fleet. Nothing hurts it. I have been 5 nights without sleep (at work) and never felt an inconvenience.” (Vincent, 2003, p.136).

Nelson’s nemesis, Napoleon, was even smaller and more frail than the admiral, just 5 inches over 5 feet in height; “The body was what doctors call ‘feminized’-that is, covered by a deep layer of fat, scarcely any hair and well-developed breasts and mons veneris. The shoulders were narrow, hips broad, and genitals small.” (Johnson, 2002, p.181.) That an Italian-speaking, nearly penniless young Corsican, thus physically equipped, could become a general in the French army at age 24 and First Consul of France at 30, then dominate all of Europe for some 15 years, suggests that there must have been something remarkable within Napoleon’s unprepossessing frame, perhaps the two related gifts that we have been discussing. Indeed, one of his thousands of biographers explains: “His capacities were immense. His energy was god-like.” (Ibid, p. 30).

The John D. and Catherine T. MacArthur Foundation gives out its annual “Genius Awards” from the bequest of a multi-billionaire who once owned much of Florida, several insurance companies worth more than \$1,500,000,000, a dozen hotels plus extensive farm and ranch lands around the

United States, oil wells, resort properties, a chain of restaurants, and a fleet of airplanes (Hoffman, 1969). Buying and selling real estate, businesses, and other property does not at first seem relevant to genius, but J.D. MacArthur knew all that was relevant about the property, about the buyer or the seller, and when knowing all this and closing the deal required him to stay awake, active and alert for 48 or more hours at a stretch, it appears that J.D., perhaps like Lord Nelson, “never felt an inconvenience”.

Edwin Land, inventor of the Polaroid camera and founder and CEO of Polaroid Corporation, was not only clever and inventive but also capable of mentally pursuing an elusive new idea for hour after hour. After his Polaroid stock was worth \$143 million, even after he had received six honorary doctorates and served as president of the American Academy of Arts and Sciences, Land’s “habits of twenty-hour days and month-long nonstop projects were unbreakable”. (Wensberg, 1987, p. 123.)

“To say that Mozart was a composer of undeniable genius is scarcely scratching the surface of this man’s gifts. His astonishing rate of production continues to stupefy scholars today. In his short life, he composed over 600 works. But, doubly unfathomable, is the peerless craft with which each piece of music was created.” (Moss, 2004). Richard Wagner, in addition to his 13 revolutionary operas, published more than 230 books and articles, on topics ranging from art to history and politics, plus more than 10,000 letters (Salmi, 2004).

Most persons who have demonstrated prodigious intellectual achievement-mathematical, scientific, musical, political, artistic, military, entrepreneurial, inventive-possessed, in addition to their special talent, the gift of abundant mental energy, the ability to remain awake and sharply focused for long periods and, when appropriate, able to shut out all distractions. Jamison (2004) defines this gift as exuberance, from the Latin (ex+uberare), “to be fruitful, to be abundant.” It seems obvious that there is wide variation in the population in mental energy and that accomplishment of significant creative endeavors varies with the product of intelligence times mental energy, so that a dearth of either variable forestalls achievement even when the other gift is plentiful.

I think there are real-life tasks or jobs or even sports that demand unusual mental energy or focusing of attention and the persons most expert in these efforts should achieve high scores on a valid test of mental energy (I suspect golfers and baseball players need such focusing more than most football or basketball players?). I would also speculate that such a person might prove to be especially competent in shutting out a consciousness of risks and dangers and thus to behave fearlessly (as did Napoleon, Nelson, and Teddy Roosevelt, for example).

It would be easy and interesting to compose a list of self-report items such as:

1. How many hours of sleep do you normally need each night?  
4 5 6 7 8 9 10
2. Do you ever skip a night’s sleep in order to finish a project?  
Never Rarely Sometimes Often
3. Arthur Miller wrote Act I of *Death of a Salesman* in a continuous 17-hour stretch; could you concentrate productively for that long on a creative project of your own?  
Never Rarely Sometimes Often

Additional items could be fashioned from questions like the following: In grade school, when the teacher sent you to the blackboard to solve a math problem, could you focus on the problem and ignore

the other children? In my bridge club, one member computed all the scores rapidly in his head (that was before hand calculators), while the members stood looking over his shoulder; could you do that? When you watch Tiger Woods preparing to make a tricky golf shot with a million pairs of eyes, like yours, watching closely on TV, do you ever wonder how he can shut out all those eyes and focus wholly on his shot? You are a behavior geneticist but now molecular biology is taking over and you buy a well-regarded new text that surveys this complex field; how long will it take you to master its contents? In an emergency, when you need to think clearly and act wisely, will you be able to ignore a painful injury or a looming threat? Have you ever become so absorbed in some intellectual project that you forgot the time, your meals, your other appointments?

I hope that a reader will devise a reliable and valid measure of mental energy, then obtain scores on this measure from a representative sample of students or employees on whom IQ scores were also available, and finally demonstrate that the product of  $e \cdot g$  predicts college grades or job performance much better than does IQ alone.

## References

- Andrade, E. N. Da C. (1956). Isaac Newton. In J. Newman (Ed.), *The world of mathematics, vol. I*. New York: Simon and Schuster.
- Berlinski, David (2000). *Newton's gift*. New York: The Free Press.
- Borwein, J. M., & Borwein, P. B. (1988). Ramanujan and pi. *Scientific American*, 258, 112–117.
- Chernow, Ron (2004). *Alexander Hamilton*. New York: Penguin.
- Dunham, W. (1990). *Journey through genius*. New York: John Wiley and Sons.
- Gleick, J. (1992). *Genius: The life and science of Richard Feynman*. New York: Pantheon Books.
- Hoffman, W. (1969). *The stockholder*. New York: Lyle Stuart, Inc.
- Isaacson, W. (2003). *Benjamin Franklin: An American life*. New York: Simon and Schuster.
- Jamison, K. R. (2004). *Exuberance: The passion for life*. New York: A.A. Knopf.
- Jenkins, R. (1997). *Gladstone: A biography*. New York: Random House.
- Johnson, P. (2002). *Napoleon*. New York: Penguin Books.
- Keynes, J. M. (1956). Newton the man. In J. Newman (Ed.), *The world of mathematics, vol. I*. New York: Simon and Schuster.
- Kolata, G. (1987). Remembering a 'magical genius'. *Science*, 236, 1519–1521.
- Landrum, G. L. (1993). *Profiles of genius: Thirteen creative men who changed the world*. Buffalo, NY: Prometheus Books.
- McAuliffe, K. (1995, December). The undiscovered world of Thomas Edison. *The Atlantic Monthly*, 80–93.
- Moss, C. K. (2004). <http://www.carolinaclassical.co/articles/motzart.html>
- Morris, E. (1979). *The rise of Theodore Roosevelt*. New York: Modern Library.
- Newman, J. R. (1956). Srinivasa Ramanujan. In J. Newman (Ed.), *The world of mathematics, vol. I*. (pp. 106–380). New York: Simon and Schuster.
- Overbye, D. (2000). *Einstein in love*. New York: Viking.
- Salmi, Hannu (2004). <http://users.utm.fi/hansalmi/arti.html>
- Spearman, C. (1927). *The abilities of man: Their nature and measurement*. New York: MacMillan.
- Vincent, E. (2003). *Nelson: Love and fame*. New Haven: Yale University Press.
- Wensberg, P. C. (1987). *Land's Polaroid*. Boston: Houghton Mifflin Co.

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