

Eminent Scientists' Demotivation in School: A symptom of an incurable disease?

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**9th International Conference on motivation
Lisboa, Portugal
2004**

“[A]fter I had passed the final examination, I found the consideration of any scientific problems distasteful to me for an entire year” (Einstein, 1959, p. 17). This is Einstein’s explanation, in his autobiographical notes, for how coercive taking exams felt to him. Einstein is not the only scientist who found school demotivating. Charles Darwin, Carl Jung, and Michael Faraday also reported experiencing boredom in school as well as not learning much. The historical psychologist Simonton (1994), in his study on geniuses of the western civilisation, concluded that 60% of the great men of the 20th century simply hated their school years.

Why had school been so demotivating for these famous scientists? How did they achieve outstanding levels in their respective domains, despite their lack of school motivation? Investigating these two questions is a challenging endeavour which involves the analysis of biographies and autobiographies – both types of documents inevitably being subjective and anecdotal in nature. This is nonetheless a worthwhile task since, beyond its historical value, such a research has the potential to inform us about why many students seem demotivated by science learning in school. The following section addresses the first of these two questions.

Why Had School Been So Demotivating For Many Eminent Scientists?

We examined the autobiographical and biographical texts from three famous scientists to address this question: the physicist Albert Einstein, the naturalist Charles Darwin, and the psychoanalyst Carl Jung.

Einstein’s Case

Ever since he was a boy, Einstein had been looking for being filled with wonder. Acquiring knowledge about the world seemed the best way to achieve his goal (Hoffmann, 1972). Unfortunately, school did not seem to fulfill his need. For this great physicist, the teaching approaches that prevailed back then were unduly rigid, military-like, and humdrum. In a letter written in 1940, Einstein explained: “I preferred, therefore, to endure all sorts of punishments rather than learn to gabble by rote” (cited in Hoffman, 1972, p. 25). In the face of Einstein’s lack of skills to remember words and texts, his Greek teacher – rather than offering him some assistance – suggested that he should quit school altogether since he was not going to achieve anything good in his life anyway. In his autobiographical notes, Einstein acknowledged that he had nonetheless met a few good professors at the Zurich Polytechnic (the Swiss Federal Institute of Technology). But, in general, he found lectures so demotivating that he did not attend them and rather pursued his own research agenda in laboratories. Moreover, Einstein became a self-directed learner. He painstakingly read major and seminal scientific work. It was during his studies at the Zurich Polytechnic that he declared that taking final examinations had killed his motivation for solving scientific problems.

Darwin’s Case

From his first day in school, Darwin experienced boredom. In his autobiography, he recollects that his teacher considered him as a generally weak student, slower than his sister (Darwin, 1958). His situation did not improve over the following years. Darwin declared: “Nothing could have been worse for the

development of my mind than Dr. Butler's school, as it was strictly classical, nothing else being taught, except a little ancient geography and history" (Darwin, 1958, p. 9). Focused mainly on the rote learning of ancient languages and on the study of literary and philosophical texts, this school did not fulfill Darwin's need and interest in exploration and for understanding natural phenomena. Because of his lack of motivation and perseverance for learning Latin and studying classical authors, his instructors, and even his father, concluded that the young Darwin was never going to achieve anything significant in his life. Besides chemistry, most classes attended by Darwin at the University of Edinburgh were in a lecture format and completely bored him. After two semesters, his father suggested that he went to the University of Cambridge. Once again, he could not find himself motivated to study. "My time was sadly wasted there, and worse than wasted" would he say (Darwin, 1958, p.19).

Darwin's strong desire to understand and explore natural phenomena was finally fulfilled, but mostly outside of the school or university setting. His thorough work on his collections of minerals and insects, the impressive amount of time he spent reading scientific materials, as well as his informal discussions with other researchers made him one of the most learned and eminent scientists of the modern era.

Jung's Case

"College bored me to death"¹ said Carl Jung (1973, p. 47). The years he spent in high school turned out to be years of boredom and rebellion against school, for this famous psychoanalyst. In his autobiography, Jung based his conclusions on two major observations: he could not understand mathematics and he had experienced difficult relationships with his teachers.

Mathematics classes terrorized and tormented Jung in college. The mathematical logic always remained a mystery to him. His lack of ability for mathematics made him ashamed and shy with his fellow students. Later in his life, he eventually confessed: "I was so humiliated because I could not understand that I never dared asking any questions"² (Jung, 1973, p. 49).

Mutual incomprehension and conflicts also characterized Jung's relationships with his professors. He was perceived as a stupid student and a liar. Jung recalls how, after he had worked seriously on a written composition that he found well done, his professor accused him of cheating in front of the whole class, claiming that he could not possibly have written such a good paper. Though Jung vehemently protested, his professor and classmates simply persisted in believing he was guilty. In another anecdote reported by Jung, his professor had found his paper original yet so unpolished that he said he was positive about Jung never achieving anything significant in his life. Only his Latin teacher put trust in him. Since Jung already had a good mastery of this language, his teacher allowed him to quietly read in the library while other students did exercises. Jung remembered mostly the unkind words of his professors as well as the unfair treatments he suffered in college. Reading and studying famous philosophers' work such as Platon, Kant, and more specifically Schopenhauer helped ease his anger.

In the light of these brief testimonies extracted from Einstein's, Darwin's, and Jung's autobiographies, we pose three hypotheses to explain why such famous researchers had found themselves so demotivated in school.

The first one resides in the lack of cognitive challenges they experienced in their school environment. The endless lectures they had to attend, along with the bulk of knowledge to be learned by rote, did not meet their needs for understanding, exploration, and certainly not for creation. As pointed out by Einstein

¹ "le collège m'assommait." In French in Jung (1973, p.47).

² "j'étais tellement humilié de ne pouvoir comprendre que je n'osais pas poser aucune question." In French in Jung (1973, p. 49).

(1959, p. 17): "It is, in fact, nothing short of a miracle that modern methods of instruction³ have not yet entirely strangled the holy curiosity of inquiry". Not being exposed to dynamic instructional approaches that could have otherwise stimulated their exceptional potential for research activities, Darwin, Einstein, Jung – and possibly numerous other outstanding researchers – found themselves completely bored in school.

The second hypothesis is rooted in the inability of their school system to value their type of intelligence. The languages and classic literature and philosophy were the main topics taught in the schools of England during the 19th century. Darwin's interests pertained rather to exploration and to understanding the natural phenomena. As to Einstein, he never quite could recall names, dates or Latin phrases; this is nonetheless what was mainly asked of German gymnasium students at the beginning of the 20th century. And regarding Jung, the mathematical logic taught in school always remained his pet aversion. His professors never fostered or valued his interest in philosophy and spiritual phenomena. Darwin's and Einstein's low grades in school tend to show that their special intellectual potential was never recognized. When they realized that the reproduction of knowledge (as opposed to exploration) and standardization (as opposed to creation) were really what was valued in school, these three great researchers rapidly came to consider school as a demotivating place, totally lacking intellectual stimulation.

The third hypothesis pertains to the difficult relationships that they experienced with their teachers. Since they were considered as ignorant, unmanageable, or simply passive students, it is mainly control, authority, and coercion that characterized the relationships they developed with their professors. As mentioned previously, in Jung's case, it went as far as being accused of cheating in front of all of his peers. Actually, these three scientists' professors attempted to force them into fitting a mold and behaving as others did. However, history would soon prove them to be rather different from the others.

Thus, the lack of cognitive challenge implied by the instructional approaches they were exposed to, the inability of the school system to value their research potential, and the conflicts with their professors seem to be the main factors contributing to these eminent scientists demotivation in school. In the next section, we address the second question.

How did they persevere and achieve outstanding levels in their respective domains?

Entering university proved to be a turning point in many famous researchers' decision to actually become scientists (Zuckerman, 1977). However, for some of them, these early years in university turned out to be boring and demotivating. As mentioned previously, Einstein did not attend the theoretical lectures at the Zurich Polytechnic and, in his autobiography, Darwin said that he had been completely bored by his undergraduate studies at the University of Cambridge. It is only during their graduate studies that a majority of eminent scientists will finally find the environment conducive to research and the stimulating support from professors they had been seeking for so long. Then, how did they persevere and keep being motivated to learn during all of those years, from primary school to their early years in university?

Simonton (1994, 1999) shows that they nurtured their motivation to learn through their personal goal to become self-directed learners. Darwin told his cousin Francis Galton: "I consider that all that I have learned of any value has been self-taught" (Simonton, 1999, p. 120). Simonton's work, as well as Ochse's (1990), and Zuckerman's (1977, 1983) show that to achieve their goals, they all used the same strategies: reading, exploration, and establishing a sustained and meaningful relationship with one or many mentors. We will now examine further these three strategies.

³ Einstein wrote his autobiographical notes in 1945-1946. The modern instructional approaches he referred to are not those we now know of.

Reading

For these eminent scientists, the one most prevalent tool for self-directed learning was reading. Darwin, Einstein, and Jung dedicated countless hours to reading during their childhood and youth. From the age of 11, Einstein eagerly and seriously read the scientific and philosophical books and papers loaned by his uncle Jakob and a friend of the family. In his autobiographical notes, Einstein recalls how – when he was 12 years of age – a book about Euclid's geometry completely filled him with wonder, he never forgot. Then, books such as Bernstein's *People's book on nature science* and those of scientists such as Helmholtz and Hertz occupied most of his time. It is through reading that Einstein built his robust science background, even before getting to the Zurich Polytechnic.

In his autobiography, Darwin mentioned how he spent his summer reading and hiking. His favorite books dealt with philosophy, religion, and of course, natural science. He discovered both *Personal Narrative* written by Humboldt and *Introduction to the Study of Natural Philosophy* by Sir J. Herschel during his last year at the University of Cambridge. These books particularly inspired him and triggered his desire to bring a significant scientific contribution to the progresses in the natural sciences domain.

It is in his father's library that Jung first encountered natural science, literature, and history related books. He commented: "I also began to read German literature and classics, given that school - with its overly detailed explanations of things that were plain obvious - had not definitely deterred me"⁴ (Jung, 1973, p. 84). It is actually while reading a book on psychiatry that he decided to withdraw from his medicine studies and to engage in the in-depth study of human psychology which eventually led him to psychiatry.

These famous people found in reading a way to learn that suited them perfectly; reading allowed them to search and to go deeper into the topics they were interested in at their leisure, at their own pace and in their own way. Simonton, (1994, p. 165) phrased it best: "To have read widely is a hallmark of those who become widely read about."

Exploration

"Nature seemed to be filled with wonderful things that I wanted to immerse myself into"⁵ once said Jung (1973, p. 52). Darwin's exploratory expeditions of many countries of South America as well as his trips to the Galapagos Islands are well known. From his childhood, he had always loved to collect mineral samples, animals, and insects. In his autobiography, Darwin explained how he sometimes became friends with fishermen in order to accompany them for fishing seashells, which then allowed him to dissect them. Laboratories were rather Einstein's favorite playground. As he highlighted in his autobiographical notes: «However, I worked most of the time in the physical laboratory, fascinated by the direct contact with experience» (Einstein, 1959, p. 15).

Exploration is clearly an excellent approach to foster one's learning. It helps put into perspective the knowledge gained from books and appreciate the actual complexity and beauty of natural phenomena. One can think that eminent scientists also derived another advantage from their explorations: it provided them with solitary time for deep thinking and reflection. Simonton, along with many other history psychologists, has stressed out how most of these famous men enjoyed solitude and even craved for it. "I lived in solitude in the country and noticed how the monotony of quiet life stimulates the creative mind" would Einstein say (as cited in Gardner, 1993, p. 103). Just like reading, exploration can often be a solitary activity allowing one's mind to freely imagine and create.

⁴ "Je commençais aussi à lire les œuvres de la littérature allemande et tout d'abord les classiques, dans la mesure où l'école, avec ses explications inutilement laborieuses de ce qui allait de soi, ne m'en avait pas dégoûté." In French in Jung (1973, p. 84).

⁵ "La nature me semblait pleine de merveilles dans lesquelles je voulais me plonger." In French in Jung (1973, p. 52).

Mentors

The first, and likely the most influential, of Darwin's mentors was Professor Henslow at the University of Cambridge. In his autobiography, Darwin recalls the countless hours of discussion and the precious guidance his natural science professor provided him with, mostly outside of the university campus. Henslow even informed Darwin that Captain Fitz-Roy was looking for a naturalist who could join him in his expeditions around the world. And it is precisely during this 5-year long journey that Darwin collected the animal specimens that led him to build his most famous theory about the origin of species. Thanks to Henslow and his scientific investigations, Darwin later joined some of London's scientific societies. This scientific community clearly motivated Darwin in his research on the origin of species.

Sigmund Freud was probably the most significant person for the career and research of Jung. As mentioned by Jung in his autobiography: "No-one among my relationships at the time could measure up to him... He was extraordinarily intelligent, shrewd, and outstanding in every respect"⁶ (Jung, 1973, p. 176). Even after he had taken some distance relatively to Freud's sexual theory and gotten into an argument with him, Jung still acknowledged that Freud "had given our civilization a new boost with his discovery of an access to the subconscious"⁷ (p. 197).

Einstein apparently did not have a mentor. However, he acknowledged how he was introduced to sciences by his uncle Jakob and Max Talmey – a friend of the family who studied medicine – when he was 12 years of age (Hoffman, 1972). His uncle constantly encouraged Einstein to study sciences and introduced him to geometry by suggesting a book on Euclide's geometry. With Talmey, he discussed extensively about sciences and philosophy, despite the age gap that separated them. Later in his life, it is Newton, Faraday, and Maxwell who became Einstein's intellectual guides. He also shared his ideas with close friends such as Grossman. And when he became himself considered as a great physicist, Einstein contrasted his views with those of other famous colleagues such as Neils Bohr and Max Planck.

Darwin, Jung, and Einstein were not they only eminent scientists to either have a mentor or to share ideas with colleagues in order to bring further their quest for new knowledge. In a study conducted with 92 American winners of the Nobel Prize, Zuckerman (1977) discovered that 48 of them had worked as graduate students or assistants with professors who were themselves Nobel Prize award-winners. As pointed out by Zuckerman (1977), the fact that 11 Nobel prizewinners have had the great physicist Rutherford as a mentor is an example of just how significant a good mentor can be during one's studies and training. It then appears that most eminent scientists did have people to stimulate them during their childhood and mentor(s) during their studies. But, what exactly is the nature of these people's contribution.

According to Zuckerman (1983), it is not so much the scientific knowledge that mentors transmit to eminent scientists that makes a difference; this knowledge is most of the time accessed in a self-directed manner through the reading of books and research materials. It is rather the working methods, the mindsets, the values, and the attitudes related to scientific research that they instill. Moreover, with the self-confidence they inspire, mentors teach also thinking approaches and quality standards that stimulate them to achieve their very best. One Nobel prizewinner interviewed by Zuckerman told him what he thought of learning with a mentor: "It's the contact: seeing how they operate, how they think, how they go about things. [Zuckerman's question: 'Not the specific knowledge?'] Not at all. It's learning a style of thinking" (Zuckerman, 1983, p. 246).

⁶ "Nul autre parmi mes relations d'alors ne pouvait se mesurer à lui... Je le trouvais extraordinairement intelligent, pénétrant, remarquable à tous points de vue." In French in Jung (1973, p. 176).

⁷ "a donné à notre civilisation un élan nouveau qui consiste dans sa découverte d'un accès à l'inconscient." In French in Jung (1973, p. 197).

Conclusion

When considering the demotivation experienced by many eminent scientists during their school years – along with the methods they developed to still persevere in their quest for knowledge – we inevitably feel compelled to reflect upon the science introduction and the research formation that we now provide our university students with. For many reasons, we appear to be facing an incurable disease.

Because of the pressure coming from many social agents such as politicians and those from the corporate world, the role of schools and universities is increasingly driven by the requirements and needs of the job market. Strict evaluation modes are put into place to assess whether students achieve the desired levels of competence; it ends with a diploma that confirms that its owner can 'do as he/she is expected to'. In such a context – where traditional selection criteria, normed knowledge, and standardized requirements rule – is it not utopian to think that creativity, originality, and marginality can be valued and promoted?

Professors' competencies are also to be questioned. Of course, most professors are qualified for teaching their subject, but are they capable when it comes to initiate instructional approaches that can challenge students and motivate them to explore or to take risks? And, do professors wish to anyway? Do we have in high schools, and even in universities, teachers who can be inspiring role models and mentors in terms of passion for learning and understanding? In other words, do students ever witness their professors explore, read, and most of all, enjoy themselves while being engaged in these activities? Or do not they rather attend routine and almost mechanical lectures in their high schools as well as observe university professors more preoccupied with their grant applications than by authentic research challenges?

Ultimately, are parents, professors, and administrators ready to accept dissidence in thinking? Of course, in both schools and universities, unusual behaviors and clothing can be tolerated up to some extent. But, would we accept students who think 'outside of the box' or go as far as to provide sufficient resources to help them carry out their ideas?

All these questions tend to call for a negative answer. This is why we believe that, nowadays, there must still be a number of potentially great researchers who are just being bored to death in school and in university. We hope that they will manage to self-direct their own learning and persevere, just like their predecessors.

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