

Logarithm Scale and Evolution *

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The trouble with spending time on a 'good university' (or having educated parents) is that it might make you incapable of thinking about certain ideas. If you are a historian trained in Harvard University, than like New York Times, you may not be able to think beyond the nations of Atlantis. An economist, who have spend a fair amount of his/her time in 'Chicago-Stockholm Express' can not digest the criticism of 'free-market'. A typical students of Jawaharlal National University find it hard to listen to what neoliberals has to say. Indian journalists trained in Western privy league universities can not believe that poor do exists in India e.g. according to Times of India, we are living in a golden age. A typical engineer or scientist can not believe that there could be some soocial problems which can not solved by implementing some sort of technology. Fortunately, on the campus of IITB (or on any campuses which takes pride in producing 'Whiz Kids' rather than Bose of Raman) we do not have these kind of problems. Actually no one can accuse us of having any radical idea. Outside India, engineers have shown tremendous diversity of thoughts. From Ludwig Wittgenstein to Osama Bin Laden, we have touched upon many facets of ideas. Indeed, seeking a career in not even tangentially related fields have now become a norm rather than an exception on most of the engineering campuses in India. I have more to say on it, see A.

It not just universities which could blind us. We tend to loose many faculties as we move ahead in our school education system. Here, I am going to reflect on logarithms (in fact, going to lobby for them) and their superiority over linear scales generally used in academia. In passing we'll touch upon many seeming unrelated ideas. Our central argument is going to be based on evolution. And social construct which might have played their roles building up our predilection for a liner scale at the cost of logarithms.

Necessity is NOT a mother of all inventions? Though necessity is mother of most of the inventions in Industrial age. Most of the early inventions might have been done out of curiosity only. Their necessity only became apparent later e.g. cooking food on fire was not a necessity, some chap might have got curious about it. But invention of scales might have been a necessity. Comparison is what we do when we start seeing. To compare we need a scale. Early humans might have liked to compare few things for sure. Size of their potential hunt and meat it can provide them. Size of their social group and of adversaries etc.

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Comparing is an old habit. Nothing has changed in this regard. In modern times, on schools or on any universities, we are always compared. Although the methods are changed. First we were compared whether we are born in a certain class or caste, now we are compared, along with these primitive social construct, how well we perform in certain competitions and how much we earn. Linear scales are mostly employed. Lets consider something we are all concerned about, marks! On a linear scale, anyone who scored 70 in one test and 100 in the next has a growth of 30; another who improved from 20 to 50 also has a growth of 30. Should both progress be termed as 'same'? On a linear scale, yes! Perhaps the the range of the marks is not quite large in which we can produce a visible contrast. Besides linear scales become more relevant when we compare seemingly 'same' entities. Students of same class can be compared on a linear scale but a high-school student and a graduate student surely can not. How about when we have to compare different entities? I can run a kilometer and and take Mr. X who can run 10 kilometer in one stretch. If somehow I am able to run 4 kilometer; will my willpower is 'same' as Mr. X should he run 14 kilometers. If yes, then this is unfair! My improvement by a factor of '4' make Mr. X run $10 \times 4 = 40$ kilometer to claim the same level of 'willpower'. What about frequency response of two amplifiers? Would you measure it in linear scale and then compare? Or pH of two solutions, magnitude of two earthquakes, level of two sounds. Then question arises which scale is more natural. Linear of Logarithm?

It is quite astonishing to note that how frequently we encounter logarithms (also pi) in natural phenomenons. One wonders where our presupposition for linear scale is misguided. Whether it is an equation representing diode characteristics, sum of an infinite series, frequency response of an amplifier, no of animals in animal kingdom (save humans) at various level of food chain, distribution or errors, definite pattern in seemingly chaos, transmission of energy in food chain, distribution of prime numbers (Prime Number Theorem, no of applicants universities can accommodate (10% for others, 1% for IIT's), distribution of most search keywords on the Internet See (or on IITB DC, you can get the data using tcpdump utility); topic of most shared article on Times of India¹ website, pH of solutions, strength of an earthquake, level of sound, decline in interest in reading and writing (and possibly in thinking also), distribution of alphabets in a write-up, frequency of wars, neural response to pain etc. If logarithmic scale is really so natural then why we have come to be possessed by linear scale?

There is very little evidence to pass a judgment on this. Written evidence, firstly very few exists, do not say very concrete about these tendencies. However there are certain patterns which give some idea about existence of some logarithmic scales in ancient civilizations. Take for example, in old Chinese and Egypt number system they have used power of 10^2 to represent their numbers. Oldest language of this world, language of Indus valley³, is still an enigma and

¹It can well be named Times of Soft-Porn or Times of Idiots

²Most of ancient civilization have used 5, 10 or 20 as their base for number system. The reason is quite intuitive. When you have to count, the simplest device is your fingers. You can use either one hand (5) or both (10). Some might have liked to use their toes also. After all not everyone was fond of wearing shoes. There is one major exception of Babylonian. They have used 60! Why one would do that? Freaks!

³Asca Parpola and I. Mahadevan are two most prominent scholar of this language. The

has not been decrypted. It contains in itself a treasure trove about early human civilization.

Before we use evolution to justify our stand, we have to say something about evolution. In fact evolution deserve a separate note. Its has been a major force in last century. Few ideas have influenced humanity in such a great extent. Evolution has been used and misused ⁴ by many. Recently many weakness of evolution has been confirmed. It is not able to explain everything. It does not explain why chicks of a hen who was put under stressful condition are also stressful and shows a tremendous decline in their learning capabilities. This disability continued in their successive generation even if their children were raised under normal condition. A small stretch of distress of mother can make her offsprings capabilities limited. Take Sweden for example. Sweden used to have a food cosumption pattern in which after every 20 years there was a severe lack of food. People born in these times have shown life expectancy well below from those who were born in normal times. Evolution has no clue about it. You may be in IIT not because it is in your genes but because your grandfather ate well or your grandmother or your great grandfather had a less stressful life.

Indeed, there is a high correlation between your social standing and your achievements [Bet83] . On top of it, it is a truism that a person born in socially backward family cannot achieve the same level of success despite of having same level of natural abilities. It is quite visible among the backwards and socially deprived caste groups. The stigma and inhumane practice of discrimination can make low of their self esteem. Anyone who is born in high social group but in a poor family only has to strive for resources. For example, the great Indian cricketer Palwankar Baloo (eldest and most talented among the four Palwanker brothers who were supremely gifted cricketer) had to go through in their career [Guh]. Evolution does not give any credible explanation how culture and social practices will influence an individual or a society in next 100 years.

Evolution is quite successful in explaining behaviors which have 'evolved' due to 'necessity' and 'interests' over a long period of time. For example take the universal phenomenon of choosing mating partners (or life partners). Robert Trivers [rob72] believes that among the mammals a 'sex with the greater minimal investment in offspring is selected to be more choosy; the sex with the lesser investment is selected to be more promiscuous and competitive.' 'In the human species', argues Steven Pinker, 'our mammalian physiology makes women the greater-investing sex', though the fact that our males also invest in their offsprings 'blunts the asymmetry, and makes both sexes compete and choose,'. ⁵. Though using different criteria: fertility for men choosing women, ability and

difficulty in its decoding is due to the fact that only few samples, that too are of very short length, are available. History tells it and present proves it that Indians have never been great writers. Though our exceptional cases are truly exceptional. Despite of spending 3000 years not writing a damn thing, some of them wrote 'Vedas', and multitude of stories including longest epic 'Mahabharata'.

⁴For example, in their anti reservation stand, some students and some section of media used this aporism *survival of the fittest*. If this is relevent for social situation then a robber shold not be charged for any robbery he does. He is *fit* to rob you and it is also a *survival of fittest*. Other major victims of this 'selfish' misuse of great men are Gandhi and Adam Smith.

⁵One comment is in order. Pinker is from Harvard and as I have argued in the opening of this article, can not think beyond the nations of Atlantis. In India our social construct of marriages defies this logic. In fact India has defied almost all of the social studies ever done in the West. This hardly holds in a 'system of arranged marriages'. However if we consider a small and certainly growing percentage of teenagers who prefer to choose their mates by

willingness to invest for women choosing men. It explains why men 'have liking for female breasts'. Just due to the fact that it symbolizes how well a female can feed their offspring should he have one with her. Woman craving for 'gossips' can also be explained in similar terms⁶. This was the only way to gather information regarding their potential mates (foes and friends also). Their tendencies to pick a 'dark hero' (dark dashing outlaws know as 'clads' in academic circle) for short term affair and 'romantic and proper hero' (caring and well meaning, known as 'dads') for marriage and relationships can also be explained. Former can provide better genes while the later can provide nurture and a stable future to their offspring. Steven Pinker [Pin07], author of the Blank Slate has more to say on it. He has also tried to figure out why humanity crave for fiction; but be advised, he is not admired in certain academic circle for really good reasons [you].

Now we have argued more than enough in defense of the suitability of 'evolution' to study language and numbers evolution. If this is right than babies, children and uneducated (or unaffected) adults should show a liking towards logarithmic scale. In fact, if you try to teach children in nearby primary school, they seem to follow linear scale up to few tens. They can give some examples if you ask them. When you insist to use abstraction e.g. ask them to use their hands to represent quantities by stretching them away from each other; they do not follow linear scale. Its not only the kids in Primary School Nichalpur who do that. Few months back a study has also confirmed it [AS10]. Apparently children in the West also tend to do the same. But adults instead use a linear scaling, in which the distance between each number is the same irrespective of their magnitude. Philip Ball, a consultant editor with Nature, reviewed this study. 'This could be because adults are taught that is how numbers are 'really' distributed, or it could be that some intrinsic aspect of brain development creates a greater predisposition to linear scaling as we mature. To distinguish between these possibilities', Seigler and his colleagues 'tested an adult population that was 'uncontaminated' by schooling'. 'The implication of their finding', they say, is that "the concept of a linear number line seems to be a cultural invention that fails to develop in the absence of formal education". [AS10]

Numbers and languages⁷ are deeply related. One can locate same parallels there also. Untouched tribal cultures of Amazon have surprised us many times.⁸

themselves, this logic that females also compete does not hold up to the level it holds in West. The reason for this is could be either very complex or very simple. During world war, there were fewer men left in the Europe than females and its natural that women over there there are more competitive (simple supply and demand). In India, males outnumberes females. They have many options to choose from. Unfortunately, larger the choices more confused one get and ended up with someone they tend to avoid. See this remarkable study done by Sheena Iyenger on 'Art of Choosing' [Iye]. On this rather a new phenomenon of 'love marriages' among Indians. See Vijay Nagaswamy's article

⁶A noted English writer Oscar Wilde once commented in one of his work of fiction, 'A man loves by his eyes, a woman by her ears'

⁷It is believed that languages are evolved to influence others rather than to tell the truth. Chimpanzee do have basic tool to build up a language. They can suffix and prefix the sound to make another but they have yet not come up with a language. This man says just because they do not know that others have thoughts and they can influence it. Using language effectively might give them certain advantages in group like saying something cool to impress a girl. The necessity of a language is there for them but they do not realize it. So I refuse to believe that 'necessity is the mother of all invention'. Possibly this loose aphorism is perpetuated in industrial age.

⁸Fortunately, in these times 'anthropologists' are not narrow minded as they used to be.

It was surprising enough for anthropologists to learn that there exists a tribal language called Piraha in which natural numbers are totally absent. For them it was inconceivable to **think** a language without having natural numbers in it. They have sounds of one, few and many which they encode by sounds of 'hoi', 'hoye', 'hoyeeiii' [Gor04]. Indeed, their hoi's have an indication of thinking in logarithmic scale. For them 105 is more akin to 100, while 1 and 6 surely are different. Another well studied tribal language is of Mundurucus which does not have any exposure to linear counting scale of the industrialized world, just magnitude on log scale.⁹

One could argue that real quantities are linear. 1 kilometer is a kilometer whether you have traveled 1 km or 100 km. Well yes and no, as Philip Ball has written, 'Many creatures, execute random walks or the curious punctuated random walks called Levy flights, in which migrations over a fixed increment in distance takes an ever longer time. Besides, we can usually assume that an animal capable of covering 100 kilometres could manage 101, but not necessarily that one capable of 1 kilometre could manage 2 kilometres (try the latter case with a young child)'. One may also like to ask whether engineer's practice of approximating almost everything is 'cheating' or just natural?

A Appendix

The doyen of Indian anthropologist M. N. Srinivas has reflected on this phenomenon many times. See [Sri96]. About *educated parents* who 'do not pay any attention to the talents and inclinations of their children in choosing careers' and force them to pick up engineering and medicine so that they can boost 'their image in their own social circle', he notices 'A surer and more expensive way of producing misfits can not be imagined and the country has been doing this for over 50 years'. Talk of professional education and IIT does not figure is not possible. He continues, 'The IITs enjoy great prestige as Institutions and they are highly subsidised by the government. Admission to them is eagerly sought after and highly competitive, but how many of those who graduate from them stay in India? Indeed, the question need be asked, how many of those who benefit from studying in the elite institutes of higher education in India seek careers in the country? Our most successful exports are our best and brightest men and women'. Since 90's, though the situation has improved a lot still what he had pointed out about the U-turn Indian media took in 90's on the question of brain-drain is still relevant, 'Until recently, some concern was expressed about the "brain drain" from India to the developed countries, and need to "reverse" the flow. But such concerns seem to have evaporated quietly, and the expatriates have become NRIs, whose dollars are more important to the country than their skills, qualification and experience. The irony of this situation seems to be lost

Whenever they studies 'tribal' they called them 'savages' and likewise names. These days they used euphemism like 'other culture' or 'primitive culture'. More importantly, they have come to accept that 'tribal culture' is least adulterated and hence can be used as a reliable source for studying our ancestors.

⁹The researchers concluded that numerical approximation ability is a basic cognitive ability that is common to all human beings, which could be independent of language. Their findings moreover run counter to the conclusions of research by American scientist Peter Gordon [Gor04] conducted on the Pirahs, a population that is geographically near the Mundurucus. These conclusions hold that the Indians' capacities are "immeasurably" different from our own.

on everyone. Greenbacks are preferred to grey cells' .

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