

# The Evolution of Language: From Speech to Culture

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Gifford was born in Edinburgh in 1820 and was described as a man of the highest ideals driven by steely resolve and guided by an ample fund of practical sense given this nature perhaps it was inevitable that a legal career beckoned Gifford Clarke in his uncle's law office before being called to the bar in 1849 as he was preparing to leave his uncle's practice Gifford received a visit from his brother John who cautioned that to prosper on his own he may well have to engage in the grubby practice of canvassing for business the reply was swift John if they don't employ me it is their loss not mine such confidence should not be mistaken for arrogance Gifford was that rare commodity a popular lawyer renowned for reaching quick fair conclusions underpinned by common sense and yet despite his distinguished distinguished legal career one which culminated in his appointment as an associate judge of the court of session Gifford always maintained a certain detachment from his profession telling his banker brother when you lock your safe at night your mind and thoughts are free and fresh but all last night and all this day I have had to investigate and make up my mind on a wretched paltry dispute between two unreasonable men about a trifle you see theology and philosophy were Gifford's true passions hisse was a mind that wandered far beyond jurisprudence finding its truest expression in the realms of ethics morals science and religion his school friends nicknamed him the philosopher and in later life he took great pleasure that his distinguished title afforded him the opportunity to deliver lectures on topics as diverse as Ralph Waldo Emerson Spinoza Saint Bernard of Clairvaux and the ten avatars of Vishnu in Gifford's view nothing but good can result from discussion remember these were the days before Twitter and he sought to give his name to lectures which would make the loftiest of topics accessible to all members of society his vision was for public talks on natural theology delivered by able reverent men true thinkers sincere lovers of and earnest inquirers after the truth and in that regard he's been well served by the quartet of universities he trusted with his bequest ultimately the strength of the Gifford lectures lies in the caliber of speaker this series continues to attract and I have no hesitation in saying that Lord Gifford would have heartily approved of this year's choice I'm now going to hand over to Mark Bailey to introduce this year's Gifford lecturer Mark thank you thank you very much Jill for that illuminating introduction to the Gifford

lectures my name is mark bailey i'm in the school of life sciences here at the university of glasgow and i'm the organizer for this series of gifford lectures i would also like to welcome everyone in the audience um no i was going to talk about the overflow room but i think we've not actually used it and also to welcome those of you watching via the live stream on the web as professor morrison has explained the giffords are an opportunity to grapple in a public forum with some of the big questions that we as humans can pose the lecture for this series is going to address what are arguably some of the biggest of these questions that have been posed by many of us throughout our adult lives what is a human being how did we end up like this and given what he will argue is our joint biological and cultural heritage what are the implications of the answers to those questions for where humans go from here many gifford lecturers approach questions of this kind from a theological philosophical or ethical standpoint but in this series we're using biological evidence and thinking to inform that debate our gifford lecturer for this series is professor mark pagle he currently heads the evolution laboratory in the school of life sciences at the university of reading he's also one of the external faculty at the highly prestigious and groundbreaking santa fe institute in new mexico in the united states he was elected as fellow of the royal society the premier scientific academy in the uk and the commonwealth in 2011.

professor pagle hails originally from seattle where he did his phd on mathematical statistics he then moved to the uk on a postdoctoral fellowship at the department of zoology university of oxford where apart from a couple of years out at harvard in the middle he stayed until 1999 when he was offered a new lab at the university of reading over his career mark has addressed problems in several areas of evolutionary biology from the process by which new species arise through understanding the diversity of human languages from an evolutionary perspective through to dating the great works of homer the iliad and the odyssey many of these problems have involved what's called tree thinking as he'll explain and many of them have involved mathematical modelling of the properties of living things amongst his other notable exploits are jointly writing a core textbook on comparative approaches in evolutionary biology and his editorship of the award-winning oxford encyclopedia of evolution he's widely published in top journals such as nature and science and he maintains a high profile in the media with many radio appearances and a ted talk under his belt mark has also written a book amongst several books but here is the one that prompted us to invite him to give this series of lectures wired for culture the natural history of human cooperation and it forms the basis for some of what he will say in this series i'd known of mark through some of his work and had also been thinking about these questions of what drove the last stages of human evolution for a number of years drawing on ideas from people like richard dawkins susan blackmore dan dennett matt ridley robin dunbar kevin leyland boyden richardson martin novak i could go on so i read this book with mounting excitement back in 2012 when it came out i found that mark had forged his ideas building on the ideas of these other workers into a marvelously coherent accessible and readable whole and it seemed to me that what he'd written was the most lucid explanation i've yet seen for why the human brain is the way it is and for what we see around us in terms of culture in terms of human behavior and human relations which are at the same time he will argue both the drivers and the consequences of our evolved brain in this series

mark will touch on the place of language and culture in the latter stages of human evolution the role and consequences of creativity and cultural innovation the relationship between physical aspects of our evolution culture cooperation and intergroup conflict and the possible future of society worldwide based on current trends and the dominance of cultural evolution so please join me on behalf of the glasgow gifford lectures committee in welcoming professor mark pagel to begin his series on wired for culture the origins of the human social mind or why humans occupied the world with his first lecture on the evolution of language from speech to culture doesn't matter too much i want to thank the vice principal for that lovely introduction and mark as well if there's a theme that ties together the four lectures i'm going to give it's we're going to try to understand the juggernaut that is the human species this is a species that evolved perhaps 200 000 years ago and then walked out of africa 60 000 years ago and rapidly occupied nearly every habitat on earth what we're going to try to do is first in the first lecture tonight and in the lecture on tomorrow night is we're going to look at the sort of tool kit that humans have and a big part of that toolkit is language and we're going to see how important a role that language has played in our exploration of the world tomorrow night we're going to have a look at the evolution of what i call creativity and we're going to find out that we're not very good at it but despite that despite the fact that we're not nearly as clever as we think we employ a trick that means that unlike any other species on earth we can accumulate knowledge our species has a history last year was different from this year 100 years ago was different 200 years ago was different if you're any other species on earth every year is the same apart from the environment changing we have a history things change for us we accumulate knowledge and technologies so we're going to try to understand what are the tricks we use in the first two lectures and then in the third lecture we're going to try to put that together and see how that created a species that has traveled around the world in little tribal groups that acted as sort of chauffeurs and helped them build the wisdom and the skills and the technologies they needed to occupy the world and in the final lecture.

we'll have a look at where we're all going with that all right let's start out with tonight's lecture the evolution of language this this lovely painting here is by um peter bruegel the elder flemish master of the 16th century and it's the tower of babel and of course the tower of babel story is a story about language isn't it and the story goes from the bible that humans had acquired language a single language and they realized that the language was so powerful it would help them work together and cooperate to build a tower that would take them all the way to heaven now god annoyed at this attempt to usurp his power destroyed the tower and famously scattered the people and here's the irony to ensure that they could never work together again he gave them separate languages so the tower of babel story is a story about linguistic diversity and the irony of it is is that human languages exist to prevent us from communicating with each other and we're going to actually see in the third lecture this is far closer to the truth than you might think and perhaps not for the reasons that you think what's more interesting is that that linguistic diversity that we think arose from something like the tower of babel has somehow labeled us given us an identity that we have used to work our way around the world all right well i'm hoping that all of us speak the same language tonight so that we can communicate and we're going to study not linguistic

diversity tonight but the the evolution of language when it arose what perhaps was responsible for it arising how we have actually shaped language and then how language has helped us move around the world and it actually sculpted us genetically all right let's start out with a little bit of audience participation now this really has nothing to do with the rest of the talk it's just kind of a fun thing to do now if you're squeamish about such things don't worry i'm not like a stand-up comedian i'm not going to pull you down here and humiliate you but what i'm going to do is i'm going to read a list of words and after every word i read i want you to clap if it's a real english word okay so okay it's it's not an intelligence test well well it is slightly but i don't want you to worry so i'm going to read a word and then what you do is if it's a real english word you clap okay it's pretty simple so the first word i'm going to read to you is we're going to start out really easy table now that's good glaswegians are good at clapping you know i've done this before and i i get a certain feeble little and we have to do it several times but just to make sure you're good at it let's try another simple word like house that's even better brilliant okay let's go on to another word pavement fractious dilatory obloquy obstreperous says something about glasgow doesn't it adam brait fewer facult sounds like a dirty word doesn't it well it is actually octocracy there's a philosopher there's a political philosopher in the crowd iraq tate and finally demonate oh are you sure you wanted to clap i made that word up you should have never heard that word in all of your existence let's see what was i doing with you and i'm sorry three of you sort of ruined the exhibition but let's go on anyway so if we have a look at these uh words like like uh food and table have a very high frequency you probably hear them just about once every day from their from their frequency in spoken english a word like pavement or disguise you might hear about once every two weeks or so and you might be asking yourself when was the last time you used the word pavement if and it was 15 minutes ago just keep quiet um a word like fractious or bellicose those are words you might hear once every three to six months words like dilatory maybe once every nine months or so so we're getting less and less frequent in in everyday human speech obliqui is a word that you might hear once or twice per year obstreperous is another word you might hear once or twice per year except it seems in glasgow uh we were starting to lose people here with words like adam breit or traduce these are words you might hear once every three to five years or so they're you know they're words that aren't used very often at all words like feculent thankfully because it's not a very pretty word is it once every 15 years or so oclocracy is something that actually applies to great britain at the moment it's a it's a political uh setup it's the rule of the rabble that's an octocracy and we have a rule of the rabble at the moment and very very few i think one gentleman over here had heard that word and uh iraq tate you might hear once every 85 years or so and then finally demonate is a word that i made up and you should have never heard and i use this this illustration this audience participation to illustrate what a finely tuned capacity for language you have you have this capacity residing in your brain that can recognize words that you may never have actually used in your own speech and you may have only heard once in a blue moon or far less than that but more importantly you can discriminate between a word that might occur only once in every sort of 100 million or so or 500 million utterances from a word you've never heard so this linguistic capacity is really extraordinary it's a little bit like these environmental monitoring devices that can pick up sort of parts per million of toxins in the environment that's how

good your linguistic capacity is okay well like i say it doesn't really have a whole lot to do with tonight's lecture other than to say that darwin thought the following darwin thought that language should justly be considered as one of the chief distinctions between man sorry about the language and the lower animals.

well let's have a look because i just told you you have a pretty important and highly tuned device so to understand language to understand whether that's true that we are the only species with language we need to know what language is don't we now this is something that linguists can argue over um until the cows come home and i don't want to do that tonight but what i do want to say is that the chief feature of human language that really sets it apart is it's what we call compositional human language we tend to speak in things we call sentences and those sentences tend to have things we call subjects and verbs and objects like i kicked the ball or she ate a peach and so on and what that compositionality means is that we can substitute and combine and recombine subject words verb words and object words in an infinite number of ways to create sentences that we've never even heard before ourselves but which we can understand because of our linguistic capacity so this is really quite extraordinary because most of the things you know you've had to learn perhaps by repetition or somebody teaching you something but with language we have this this infinite capacity to generate new sentences that people have never heard before and yet they understand immediately because of this compositionality so this ability to combine and recombine words into their subject verb and object roles gives language this capacity with 25 words of each kind you can already generate 15 000 sentences and with 100 of each kind you can generate a million and it's been a while it's been about 20 years since i had a three-year-old but i'm told that three-year-olds have 200 words and so even at the age of three we can already generate huge numbers of sentences and this is just unlike any other thing on earth all right well let's let's see for the buffins in the crowd let's get a little bit technical compositionality makes language a digital form of communication words are either on or off they're either there or they're not and they're chunks and they tend to self-correct our words other animals communication is what we would call analog by comparison to a digital form of communication so most animal communication is how loud how bright how long a signal lasts how smelly it is how colorful it is these are analog systems but language is a digital system and one of the features of digital systems and you all appreciate this if only in a as a sort of um common parlance sense is that digital systems are capable of great fidelity and great variety so we can transmit digital signals with extreme accuracy and we they're capable of generating a great variety of of um sentences okay what about the other animals let's have a look well all animals communicate and so do even most plants and here's a whole book on communication in plants but do they have language well here are parrots that famously speak don't they they use words but of course the difference between their speech and ours is they're simply mimicking us they're imitating us they're not generating new sentences and those sentences can be amusing to us and they can even take a darker side which i'm going to show you but they're not what we would call language they don't on their own spontaneously generate and combine and recombine words into new sentences and they wouldn't understand one if you told it to them and the dark side of this is the following here is a parrot that that one there in that picture this pet parrot helped convict a



woman of murdering her husband by constantly saying don't shoot don't shoot in the husband's voice after witnessing the crime so keep the parrots out of your house don't talk to them don't talk in front of them forget all this gdpr stuff parrots are much more dangerous okay oh and like tonight if you're worried about your voice being recognized when you ask me a question after the lecture just disguise your voice okay it's like say don't shoot don't shoot all right um so parrots don't speak adam plants don't speak dr doolittle accepted um what about dolphins so about every three or four years we see some breathless report on the bbc or in the newspapers about how dolphins can speak there's one in 2013 dolphins call each other by their name everybody says oh dolphins are speaking to each other scientists discover that dolphins can speak almost like humans that almost really carries a lot of weight there and killer whales say hello these animals as much as we hear they don't have language now some of you might be thinking wait a minute wait a minute i talked about a digital system and we know that um dolphins and killer whales echolocate with dot dot sound and you could think that's a digital form of communication but in fact that's just being used to image their environment or to signal their their their presence in an area it isn't being used to generate brand new sentences that they combine and recombine all right well dolphins can't speak let's go up a notch how about chimpanzee signing so many of you will know that there are long-term field projects with chimpanzees in which they are forced to sit down with a human day after day after day and they have to do things like touch their nose when the human touches her nose and they're given a banana for doing that so i call this harassment they they they call it a scientific research project and the idea is to try to get chimps to use sign language which really really reluctantly they do after years and years and years and years of harassing them like this they'll sort of do this with their hands with sign language and it's just more or less to make these people go away or to get a banana and i am being irreverent about this and i'm being light-hearted about it but what we don't see with the chimpanzees is them generating new sentences in which they endlessly and effortlessly combine and recombine words in into new sentences and this um particular chimpanzee is a famous one he uh we heard that noam chomsky was an earlier lecturer in this series he's a very famous linguist well this chimpanzee here is pretty good at signing in fact one of the best and he's called nim chimsky sorry i didn't make that up and he has the record for the longest sentence that a chimp has ever produced with sign language and what i want you to see is there's there's a quality to this sentence which is that it has nothing to do with communication but all about desire and in particular desire for food because that's what animals want right okay so here's his sentence and let's i'm going to read it and then we're going to all read it together to get a sense of what in fact let's just all read it together i'll go like this to get a sense of what it's like to be a chimp are you ready so here we go his sentence goes give orange me give eat orange me eat orange give me eat orange give me you come on if one of your friends said that to you you would just push them away so what i'm trying to what i'm trying to point out here is that we can get animals to communicate we can almost force them to communicate in what are what are sort of operant learning sorts of paradigms in which if they do something we reward them but the feature of human language that is really extraordinary is that children any of you who've had children will know that they talk whether you want them to or not but most importantly they don't speak for a specific reward whereas all of this chimpanzee signing work as

impressive as some of it is all about those animals getting rewards and the rewards they want is food not surprisingly okay so if if if we are the only species that has this compositional language in which we can endlessly combine and recombine words let's find out when it evolved all right well mark mentioned that i i use things called phylogenetic trees a lot in my work.

this is what's known as a phylogenetic tree or a family tree of a group of species known as the hominins and the hominins are everything sort of north of the chimpanzees so that tree shows you that sometime around six or seven million years ago we shared a common ancestor with the chimpanzees and then a group of us broke off and formed the lineage that would eventually lead to modern humans and many of you have heard of one of the early species in that lineage was this lucy the australopithecus species a little short thing like this kind of barrel chest that walked around like that homo erectus was an upright ape that walked on the the savannahs of africa homo erectus is really the first thing that deserves the the name homo in the sense of human in that it gone was the barrel chest and the really long arms but if you bumped into this thing at night in the dark you might think it was another human that's how human-like they were and then there's these things the neanderthals which many of you have heard of their sister species to us and very recently this species that is very closely related to the neanderthals known as the denisovans.

now why do i put all these up here i put them up because not a single one of them has language as far as we can guess except us and so let's have a look here where we think language evolved it's that's that's correct what that means is that language evolved somewhere along the lineage after we split off from the neanderthals and leading to us and the criteria that we use to decide whether a species has language we obviously can't go back and find written work from australopithecine or homo erectus and so on but we can look at their toolkits the artifacts they leave behind and what we see in these species is none of the complexity and the sophistication that we're so accustomed to and takes so for granted with humans very very simple tool kit that those species had by the time we get to neanderthals it's a little bit more sophisticated but as i'll go over tonight a few times i don't think the neanderthals had language and i'll i'll give you some genetic reasons for that okay so it seems like then language arose with the origin of our species which is probably about 200 000 years ago now very very recently some people have have suggested that maybe we evolved more like 300 000 years ago i think that's probably wrong i think these species that they're finding that are um 300 000 years old or what we would call pre-modern humans they're our ancestors our direct ancestors along that branch but they weren't the modern humans that that we think of as ourselves so like i say there's some disagreement some people think that language evolved in the common ancestor to us and the neanderthals and part of the reason people think this is that neanderthals seem to be fairly sophisticated we interbred with them so it seems but let me give you a good explanation for why i don't think they had language a lot of people disagree with me on this but i think it's just correct that neanderthals didn't we'll see why okay well what does 200 000 years ago mean this is for the sort of younger people in the audience um 700 years ago was the battle of bannock burn and i'm sure i don't put quite the right accent on that when i say it the romans were about 2 000 years ago the ancient egyptians in stonehenge more like five thousand years

ago the first human village is about only ten thousand years old i said we arose two hundred thousand years ago and we lived as hunter-gatherers exclusively until about 10 000 years ago when the first village was created and then 20 times further back in time than that was probably the origin of language when we were all hunter-gatherers about 200 000 years ago okay well language why us and only us why if i'm arguing we're the only species of language why us and more more importantly maybe why only us why not any other species let's have a look at four pieces of evidence and not a single one is conclusive no one's ever really going to know why we have language and only we have language but we're going to try to explore some of those ideas a little bit more tonight and give a sense of it well one is that we can look to the extraordinarily rapid expansion of the human brain over the last two million years or so you can see that running up through our ancestors these things that would trace back down to our common ancestor with chimpanzees there wasn't much change in brain size but sometime around two million years ago brain size just took off it absolutely skyrocketed it is extraordinarily rapid increase in size and so whereas you could say these these chimpanzee-like things were really just a jaw with a little tiny head on top humans are absolutely the reverse we're an enormous protruding brain with a small jaw that's the difference between us we went from a brain about this size about 300 grams or so to a brain about this size like a large cauliflower about 1300 grams or so okay and when the human genome was first published in 2001 the the molecular biologists had a look at the sequence of that genome and they found a gene in there called har1 which turned out to be the most rapidly evolving sequence in the human genome and har1 is a brain gene it's all about enlargement of the brain so for some reason we've been going through this extraordinarily rapid increase in brain sizing and if you look at the the letters here these are the these are the sequences of dna these are called the the bases the little chemicals that are the sequences of dna if you look at ones that are in color not black there are differences between us and all of these other animals and if you look at all of the other animals they're very very very few differences but between us and the chimpanzees about five six million years or so back to them there's already i think eighteen differences it is all right so very very rapid evolutionary change acting directly on the brain rapidly uh increasing the size of the brain and this is not meant in any way to to to be exhaustive and it's even out of date and it's almost like i use it almost because it's out of date just to show you that there's lots and lots of genes being acted on in the human brain and our brains are still changing this gene here microcephalin is still evolving it's still sweeping through human populations this gene here is still evolving it's only around 6000 years old still sweeping through human populations here's a gene that was discovered really rather recently that seems to be directly involved in cortical expansion so something dramatic is going on with our brains and one of the things you need to understand when you're studying evolution is that things don't just happen because it would be fun to make a bigger brain those brains have to pay their way brains are extraordinarily costly organs to maintain so they're they're about 1500 grams that's a tiny percentage of our body weight right but so 1.5 kilograms and many of you will weigh something like 40 50 60 70 kilograms but the brain alone at rest accounts for 20 of our basal metabolism so extraordinarily costly organs to maintain and one of the reasons why other animals have such small brains compared to us is they can't afford to feed them so we've somehow figured out a way to feed our brains okay well i said to you



that um fox p2 was or i said to you that there there was a a gene that was going to tell us why the neanderthals didn't have language and we'll get on to that in just a second but here's the closest thing to a genetic smoking gun for trying to understand human language fox p2 is a gene that creates a product in the human brain that changes the way a lot of other genes do their business in the brain all mammals have it all mammals have it i think even all birds have fox p2 and it's extraordinarily conserved most animals have exactly the same genetic sequence of fox p2 now this gene was discovered in 2002 and what was extraordinary about it was the realization that even though all the other animals had more or less the same copy there were two differences between our version of it and the chimpanzee version of it and what was really interesting about that is fox p2 now it controls the reason it's thought of as a brain gene is that it when we have mutations in the fox p2 gene people lose the ability to have the fine motor control of their of their mouths to produce words and they also suffer real linguistic deficits deficits of grammar inability to make complex sentences so it seems to be a gene that's really directly involved in language and a very fun thing this is what things like that molecular biologists like to do is they took a version of the human fox p2 so this is the version that differs from the chimpanzee and they inserted it into a mouse brain.

what do you think happened well it wasn't quite this it wasn't quite this the mouse didn't start dancing around like mickey mouse but the mouse squeaked differently not sweet so it does seem to be a gene that's directly involved in language somehow all right now now a little bit embarrassing for me was that when the fox p2 gene was sequenced in the neanderthal genome the undertold genome became available i think right around 2008 or so it was found that humans and neanderthals had identical sequence of the fox p2 genes this is why a lot of people jumped on the bandwagon and said uh neanderthals spoke but i don't think they did and the reason is that when we look at fox when we look at neanderthal social structure and when we look at their what's called material toolkit we don't see any of the sophistication that we see in humans and i'll get on to this in more detail in a moment but they just seem to be very different to us in their sophistication socially and culturally and in their in their in their sort of tool kit that they can produce and have a look at their brains their brains are completely different to ours very very different brains where we've got this tall forehead that houses this huge cortex neocortex the the neanderthals have this sloping back brain okay so a little bit of an embarrassment to me but i held my ground i had people come up to me at conferences grab me by the lapels and say how could you possibly say that neanderthals don't have language and here's why i was vindicated because a few years ago some workers found that there was a recent evolutionary change that affects what's called a regulatory element in the human fox p2 gene we use our fox p2 gene differently from the way neanderthals use theirs so the fox p2 gene affects at least 61 other genes that it up regulates it makes them fire more they make more of their product and it reduces the products from at least another 50 in our brains and we regulate our fox p2 that is we express our fox p2 differently from the way the neanderthals do okay so i don't think the neanderthals spoke and we'll see some more evidence for this in a moment all right so it's looking like language arose something like 200 000 years ago and if you ever get a chance to to read um eh gombrick to your to your children he has a lovely quote about

humans and neanderthals and he says now if all of our thinking goes on behind our foreheads and these people didn't have any foreheads he's talking about the neanderthals then perhaps they didn't think as much as we do or at any rate thinking may have been hard for them okay this is probably exactly the case i have a feeling that being a neanderthal was a rather plodding and literal existence not the richly symbolic existence that we lead and let's have a look at some evidence for that let's have a look at human symbolic thinking so i've said we've had language since at least 200 000 years ago by 40 000 years ago look at the extraordinary sculpture and art and musical instruments that we were making so in the sculpture this is this is the the famous venus figurines they're about they're about this big you can hold them in your hand the venus figurines many people think they're a sort of sexually exaggerated female form um that quite extraordinarily the lion man of hollenstein this is a combination of a lion and a human form so this is symbolic thinking at its richest and i really encourage you to try to i think the the lion man i think he's in the um the british museum in london i really encourage you to see it quite extraordinary objects we're all familiar with the cave art you can see it in the south of france at least 33 to 35 000 years old extraordinary cave art and perhaps you didn't realize that by 40 000 years ago we had musical instruments and they were playable this one's been been played now for all i know these these capabilities went back even further but of course these things decay don't they now by comparison you see none of this in the neanderthals absolutely none there is no evidence of sculpture no evidence of art i'll show you a controversial thing in just a moment and certainly no evidence of musical instruments and i think that when modern humans walked into western europe around 40 45 000 years ago the neanderthals were already there i'll bet they came walking in you know daily dressed playing musical instruments they probably had alcohol they had art displays and the neanderthals would have been sitting there around a campfire just cold and wet leading their sort of literal existence so it would have been a very very dark time i think for the neanderthal okay there was a paper this is just a larger picture of those two so you can just see how extraordinary there are there was a paper um um last year 2018 that claimed that there was the first and only evidence of neanderthal art yet this is highly controversial and i i ask you to look at it after having seen the beautiful stuff i just showed you to see that if this is neanderthal art it really is just doodling it could have been happening almost by accident it isn't the highly symbolic forms that humans produce and this is highly controversial um and most of the the paleontological world and archaeological work doesn't agree with this okay so we've had a look at the rapid expansion of the human brain we've had a look at the fox p2 gene we've had a look at symbolism let's look at the final thing about humans that perhaps is why we have language and only we have language oh look oh you didn't fall for it that little baby that little baby is doing something that only humans can do now i mentioned a lot of you are sitting there thinking no my dog can do this they can't neither can chimpanzees what that baby is doing is demonstrating theory of mind by pointing that baby at age whatever that is 18 months two years already realizes that the contents of its mind are different from the contents of your mind otherwise it wouldn't have to point the thing out would it it's an extraordinary thing that only humans do there is some suggested suggestive evidence in some bird species that they might change the way they cash their food in the ground if they think another bird is watching but it is really just suggestive but this this feature of the human consciousness

theory of mind we know that we can have thoughts about our mind relative to others minds and this theory of mind as soon as this baby realizes that it can make a noise let's call it language it can make a noise and objects will will as if by magic get picked up and move across a room and maybe end up in its mouth think of the realization that gives you so having a theory of mind almost compels us to speak as soon as you've got a theory of mind you want to talk to others you want to manipulate them you want to share with them you want to cooperate with them so having a theory of mind is what appears to be unique among humans and is probably one of the most powerful reasons that we have language and no other species has now i often tell audiences and it's a hard thing to understand but we can sum this up by saying that the other animals don't have language because they don't have anything to talk about and people reject that and say well if i gave language to a chimpanzee they'd have lots to talk about they wouldn't because they don't even have a theory of mind so for example if you i'll come back and pick on your dogs for a moment you know that if you go like that and point at something your dog won't go like oh what's over there like that it'll come up the end of your nose your ends of your finger and smell it right same thing with chimpanzees you never see chimpanzees getting together in a troop of chimpanzees and say hey guys look up there they don't have that thought their their thinking is just that they're thinking but they're not having the thought that and so one of the reasons we have language is that we're probably one of the only species that has something to talk about because having theory of mind means that we instantly have this idea that we might want to compel others in some way so theory of mind almost makes language inevitable okay there's our four reasons now let's move on we've we've looked at our four reasons for why we have language and uh perhaps only we have language let's look now at having this capacity what we have done with it because it we've turned around and we've actually forced language to adapt to us this very very powerful thing we have we forced it to adapt to us and darwin was was sort of aware of this way back when in the descent of man in 1871 where he said the survival or preservation of certain favored words in the struggle for existence is natural selection and we'll see that he's right that that we actually exert a form of natural selection but in this case on a cultural object a word something that gets transmitted not genetically from parents to offspring but from mouth to mouth from mind to mind and there's there's a couple of ways that we can demonstrate this and and they're they're quite accessible i think you'll find them fun let's ask how many english words are there well the oxford english dictionary says there's about 250 000 words and most linguists would say there's about 50 000 of those words in use and if you're really really good you might know quite a few of those or at least be able to recognize them but how many words are possible well let's just do some simple arithmetic to figure out how many words are possible let's say that english conventionally has five vowels a e i o and u and 21 consonants let's just make this really really simple assumption so how many five letter words are possible and let's make the words to be just like the word there so they go consonant consonant vowel consonant vowel.

well if there are 21 consonants there are any of 21 consonants that could be the first letter and there could be 21 more consonants that could be the second letter and then for any of those we could have any of the five vowels and then any of the 21 consonants and then any

of the five vowels and that gives us five letter words 231 thousand five letter words but hold on i haven't done my arithmetic completely have i because that's just five letter words that are exactly the same order is there consonant consonant vowel consonant vowel.

i need to ask how many five letter words are possible if this ordering of vowels and consonants can be any way you like and the answer with fives some of somebody doing a level maths in here should know the answer to this the answer was five is there's there's ten ways we can arrange these five things chosen two at a time or three at a time so there's actually two million three hundred and five thousand five letter words two million of them let's go on to a word like letter same thing consonant vowel consonant consonant vowel consonant there's four million of those that are just like letter but in this case there's 15 times that many if we allow these things to take any order as possible so about 75 million six letter words this is starting to look pretty paltry isn't it okay and how about four letter words i put them last because four letter words we think of as the sort of dirty words turns out there's lots of four letter words for forty six thousand um with one vowel eleven thousand with two and we can do the same sorts of combinatorics and see that there's more what you should take away from this is that is that the system we have erected and this is a gross simplification because we don't actually think of words as being is comprising a whole lot of letters we think of comprising sounds and there's many many more sounds than there are the 26 vowels and consonants so this is a gross underestimate what we realize is that the words that we use in everyday speech are an enormously rarified subset of all possible words so human language we have selected an extraordinarily tiny subset of the words that work for us and we'll see what some of their characteristics are in a moment so we don't have words like bakagu even though that's a perfectly good english word we don't have that word so the words we use are extraordinarily tiny subsets so darwin was right words have had to compete for survival in the environment of our minds and let's have a look at what that environment might be like well let's pop up make another plot here and this is a plot of the length of a word and again this is extraordinarily simplified because i'm just plotting the number of letters in the word not the syllables just the letters because it was so easy to do this here's the number of here's the length of a word and here's how frequently it's used in everyday speech so this is put on a scale of per million utterances and the first thing you should see here is that if you want to be used a lot as a word if you're a word that wants to get used a lot you got to be short look at that if you go if you want to be used more than around 4 000 times in every million utterances you've got to be around three or four letters so these are the words like i he she it you and so on all of these words that we use over and over and over and over are very very short the number words we use over and over and over also very short one two three now what are these words here if the words that are long are the ones we almost never use so what are these words well that one is u we use u over and over and over and u is effectively a single sound isn't it so calling it three letters really overstates the case it's just a single sound what's this word here you're all dying to know any guesses as to what this word is it's not very interesting it's telecommunication but the point i want to make about telecommunication is that this is a perfectly good english word and we could substitute it for the number word so rather than counting one two three four five let's substitute it for two so one telecommunication three four five why don't we

use telecommunication for the number two perfectly good word the reason is its length obviously so you can see natural selection in action in our use of words the words we use a lot we have forced to be really really short it gets better than this we've also made them easy to pronounce so frequently used words we know are short but they're also easier to pronounce they have fewer what linguists call obstruents now obstruent is a word i should have included in that list because you've never heard of this word it's aptly named because an obstruent is a sound that obstructs your airway and that's hard to to pronounce words that that have obstruction so compare words like i he she you very poetic they just roll off your tongues there's no obstruction of your airway with words like table mouth i have to obstruct my airway a couple times tongue and if you take a look at the frequency of use of these words in old english english german and french you see that the more we use a word the fewer obstruents it has okay so our words that we use are a highly select subset we shorten them the more we use them and we make them easier to pronounce and so darwin was right we've taken this powerful thing called language and and we have carved it and sculpted it to make it most useful for what we use language for all right coming down the home stretch a case can be made that language has played a more important role in our species recent circa 200 000 years evolution than have our genes and this is a bold statement um who's who said that it was it was actually me that said that so i'm going to have to justify this now so once you've got language you can make plans you can cooperate you can share you can club together you can record instructions for things so vice principal mentioned that i had dated the homeric iliad and you have you many of you will have read bits of maybe all of the iliad and the odyssey that thing wasn't written down it was later but it wasn't in homer's time it was recited as poetry so language is this powerful thing that we don't need writing for to carry huge amounts of information and 200 000 years ago when language evolved we would have been using it for those purposes planning saving instructions passing on information all right so what has happened with language well let's take a look at our species history now this is a sign i particularly like and i hope some of you can come to other lectures this will appear in in other talks in this series

what's being plotted here is the geographic range of a species in different points in in time here's the geographic range and what i want you to see here is that for almost all animals on earth bar ourselves animals are forced to live in the regions of the earth that their genes adapt them to so most animals are confined to a relatively tiny space on earth where their genes adapt to there are no primates in north america all chimpanzees are found in a tiny part of west africa and there's no evidence that they ever ranged widely around the world their genes adapt them to a particular way of life even the neanderthals these things that we thought were meant to be so intelligent or others do and i've been trying to argue tonight i didn't think they were to try to understand when language evolved even they were confined to just europe they were adapted to europe they had been living in europe for 300 000 years before we arrived and they weren't able to do anything else but that but then look what happened we came along and we spread out around the entire world a bit like a mushroom cloud and i use that metaphor because we have had that sort of impact on the world like a nuclear explosion we really have been a juggernaut now i taught you something about a half an hour ago which is what happened right around there corresponding to about



200 000 years ago what happened language evolved didn't it so language evolved about there and you can see that as soon as we acquired language around 200 000 years ago and before that we were these pre-modern species i think we spread out around the world we walked out of africa and occupied the entire world and here are some of the the roots that we took so a lot of people believe now that humans evolved somewhere most people believe in east africa whether it's in in this part of east africa or down in south africa it's not really clear that somewhere in east africa and by around 60 000 years ago we walked out and started occupying all of these different places on earth coming across the the bering land bridge about 15 to 20 000 years ago and then we literally sort of jogged all the way down to the tip of south america getting here only a few thousand years after we had crossed over here and then the final occupation of the world was the extraordinary movement of the polynesians only around 6 000 years ago out into the vast pacific where they occupied virtually every island in the in the pacific only getting to new zealand believe it or not about a thousand years ago okay and in doing so they left behind about seven thousand different languages and we'll have a look on the third lecture of why those languages exist but for now here's a here's evidence that as we went around the world we for the most part weren't even able to talk to our neighbors we left these 7 000 different languages around and in fact as we were moving around we would have left many more languages now these are just the contemporary ones okay so with language we spread out around the world and rapidly and and that spreading out and occupying new habitats new environments required us to develop technology and skills and knowledge for those habitats and it's created our ethnic diversity that movement around the world so today's tribal cultural and ethnic diversity owes everything to our migration out of africa beginning about 60 000 years ago and these different kinds of people exist uh in in some ways because of the the habitats they occupied but also because of a peculiar human habit of creating tribal identities which we'll talk about in a later lecture and and many of these kind of ornaments and and and ways of of dress and so on arose at those times okay but what we want to talk about is is did language really have this extraordinary influence on us because language powered us around the world no other species had been able to do that like us the only other species that occupy the world do so for some slightly boring reasons things like the bacteria things like the rats that have sort of have sort of parasitized us but we occupied these new habitats and became sort of different people as we we went around the world and in doing so we had to respond we had to adapt at the genetic level so in a sense language has sculpted us genetically we sculpted it by making words serve our interests but then language helped us move into these new parts of the world where we had to respond genetically here's a really good example of this this is a a dinka nomadic pastoralist who lives in sudan and this is an inuit who lives up in what we would call alaska and have a look if you look at this guy he lives in an extraordinarily hot environment and everything about his body is designed to lose heat everything about his body is designed to lose heat he's tall and rangy really long arms very very tall i've been around not the dinka but i've been around people like them and in heat that causes people like me to collapse they're just wandering around happy because they they lose body heat by comparison this guy lives in one of the coldest places that humans ever occupy and look at his body he's short and squat everything about him is designed to retain body heat now if we look at here's just a good example if we

if we look at the sort of pelvic breath what we see is that the the east africans are sort of slender hips compared to the inuits and the east africans have got these long bones of the arm just showing as if we needed to the long arms and and these are genetic differences these aren't just difference that arose because one of them woke up an inuit one day if you were to take an inuit baby and raise it as a dinka it would look like an inuit if you were to take a dinka and raise it as an inuit it would look like a dinka these are genetic differences and they arose because language carried us around the world thrusting us into new environments where we had to genetically adapt to survive right a number of these genetic adaptations have been identified around the world as we moved around the world some of the best known are the high altitude adaptations so for people say in tibet there's some people in the ethiopian highlands and people in in the andes mountains you know who live above 12 13 14 000 feet and they've developed specific genetic adaptations to help them live in that really thin and rarefied air there's lots and lots of other ones of them we don't need to go into them all but there's adaptations for living in cold environments these are genetic adaptations not just putting on lots of clothes there's there's adaptations against disease you'll all be familiar with certain malaria adaptations there's adaptations to drinking milk i showed you this this dinka tribes guy this nomadic pastoralist they drink milk we don't normally as adults digest milk and so we've had to develop the ability to digest milk as adults and really only those of us who can trace our ancestry back to dairying people have that ability to digest milk it's it's common in europeans it's rare in most places around the world all right so many many many of these genetic adaptations that arose simply because having language we were able to move around the world as we did all right i'll i'll i'll begin to end by showing you a really extraordinary example of this and showing you how powerful these genetic adaptations are with a nice little example of nature versus nurture nature versus nurture at 14 000 feet about 4 200 meters in tibet so this guy here is called joshi and he is a tibetan man and he's about 40 something and he's a heavy smoker so here's joshi 40 year old tibetan smoker this chap here is 19 years old and he's a fit anglo-saxon who has enjoyed all of the privileges of life sanitation clothing warm homes lots to eat so on and so forth gyms to work out in and this guy and joshie went up this mountain and this fit 19 year old could not keep up with this 40 year old heavy smoker the tibetans have this genetic adaptation known as epas-1 that allows them to survive efficiently in the thin rarefied air high up in tibet so there's a good example of the power of this genetic adaptation that was brought about by language in allowing us to occupy these regions this guy here would just be seasick sorry i mean altitude sickness all of the time in that area okay like any good teacher i'm going to end there and summarize what have we learned tonight um we've learned that human language is compositional that's what distinguishes it from other forms of communication in animals language evolved about 200 000 years ago only humans have it there was a rapid expansion of brain size we have this fox p2 gene these very peculiar changes in the fox p2 that seem to be implicated in language we have symbolism like no other species has ever demonstrated and we have a theory of mind which i suggested to you as an extraordinary difference between our minds and the minds of all other things that really compels us in some way to speak so vigorously do we use language that our words must compete in a struggle for existence in the environment of our minds

we have sculpted language and then language has turned around and sculpted us by steering us into places around the world where we had to adapt at the genetic level.

okay i'm going to end there and just say thank you very much thank you very much professor pagel um is it okay if people ask you some questions yes just now so um danielle if you could do the honours and video um they're going to bring around microphones for anybody that wants to ask a question so if you could just put your hands up and wait for us to select you um a microphone and a gdpr consent form will be brought to you just give us a sec to get organized if there is anyone downstairs in the overflow room that can hear me do please come up if you want to ask a question okay joanna please go ahead so as you indicated there's evidence of early modern man and neanderthal interpreting would you speculate um if the first f1 hybrid if you like was capable could be capable of language yeah now so it's a very good question and um so the question is there is some evidence that the humans and neanderthals interbred and so would the offspring of those have been able to to speak so obviously this is pure speculation right but what what's what we have to bear in mind about that offspring is it it would have inherited the genetic instructions to make some sort of amalgam of a human and a neanderthal brain and so we have to worry what that brain would be like on the other hand so that was a way of suggesting maybe it couldn't speak on the other hand what's intriguing about these offspring is that they must have lasted long enough that somehow that signature of interbreeding with them entered the human gene pool so i think we just don't know the answer but the but the suggestion is those offspring were viable you know so lucky him or her right a neanderthal that could speak because of one of its parents yeah okay thank you did we have a question down here somewhere yes danielle thank you i was interested in those studies you mentioned about the frequency of words and how often we hear them how is that found out what's the method to find a frequency of words yeah the question is if you didn't hear the question is how do we find out about how often words are used so there's something look it up online there's something called um one of the best examples so they're called corpora and the british national corpus is a huge database that has been compiled by linguists over many many many years and these linguists write down how often words appear in written work so they just go through books writing down words it's an extraordinarily tedious thing to do google has made it a bit easier with with text reading but then also these people go to television programs radio programs tape recordings of people speaking so it's extraordinarily hard one data but it's these things called corpora and they exist for from many languages other than in english i think there are some up here this row here thank you william so this might be somewhat short-sighted of a question but i was wondering how body language fits into this because it seems like everything has kind of been necessarily spoken language as opposed to language in general because animals absolutely do have things to talk about stay away from my food i'm not friendly don't come into my territory they just don't speak it to each other you know they have body language that they communicate to each other they just might not have the same thought patterns that we have but they don't think about their future maybe but just because we don't think the same way and use the same language doesn't necessarily mean that they're not capable of language and it's just kind of like a human thing to put our view of what language is and kind

of be the the gatekeeper for what language is and how we're different from other species yet not really and i have a hard time believing that neanderthals weren't able to communicate and we're just wandering around bumping into each other you know like they were probably able to communicate in their own language but we have deemed it language as spoken language and that's what language is you know really good question and and um what you you sort of answered your own question about the other animals and let's take up neanderthals in just a moment you sort of answered your own question with the other animals because all those examples you gave don't require language i just have to growl at somebody to say stay away from my food so it's not really language it's not really conversing i'm not saying hey please stay away from my food you say okay you you just growl yeah so so so you so you well i don't know if it is language it's communication isn't it so if we and you might say this is this is sort of making this almost a tautology if i say that language is compositional communication but that really is the feature that distinguishes human language from two wolves growling at each other or somebody beating its chest or a big beautiful sexually dispected sexually selected display of some bird now as for the neanderthals i come down really hard on them because nothing in their material culture suggests that they had anything like even approaching the symbolic thinking that we did let me give you an example there's no evidence that neanderthals even had sewn clothing that they wore skins there's that no one's ever found a sowing awl in in neanderthal remains now i think what we can this is a very sensitive and slightly awkward subject but we can imagine humans let's think about really really young people really really young maybe a three-year-old they can communicate but you wouldn't ever expect them to build a computer to paint a picture you know a lovely picture on the wall of a cave so we can imagine psychologies and psyches and cognitions that are capable of speech but aren't as sophisticated as our own and so i don't mean to say that neanderthals were wandering around like a like a group of dogs or a troop of chimpanzees but i don't think they showed anything like the symbolic thinking and the planning thinking that that we showed that's why i said that i think they lived a very literal existence now this is a it's a very um um it's it's it's a it's a it's a stance that's sort of easy for me to take in the sense that it's hard to prove me wrong but what i do say is go out and find the evidence for the symbolic thinking go out and find the evidence for the material culture and over the years more and more and more artifacts have been attributed to neanderthals that look really modern and they look like the stuff that we did but when those are studied further because modern humans often occupied neanderthal sites they've kicked them out and occupied them um that stuff's actually modern human so i think the the jury's still out and um um you know this this is a field that people opt to just jump into with both feet and try to find that evidence that's why i used evidence of the beautiful things that we were producing by 40 50 000 years ago no evidence whatsoever in the neanderthals so i think a very literal existence hard for us to imagine it but it's one of the things that's difficult in listening to lectures about humans especially from an evolutionary perspective is you take yourselves for granted but you're totally extraordinary in the animal kingdom i'm just sitting here thinking and having the thought that um it could be unique maybe neanderthals did i'm not sure i don't think they did okay time for maybe one or two more um before we stop i think there was some much more towards the top was there anything up there there's one over here on our right thank

you hello sam you said towards the beginning of the lecture you mentioned that one of the differences between humans and other species is that um last year for humans is different 100 years ago for humans was different 200 years etc is different from today whereas for in other animals each generation is roughly the same but um there are isolated communities of humans uh who um they they don't seem to they don't develop new technologies from generation to generation uh and uh it seemed i was i was wondering if you think uh why is it that it is why is it that you think that it is language why um modern humans their lives seem to change from generation to generation and is it would you not say it's more a consequence of agriculture of the agricultural societies that are yeah so thank you for the plug because for uh the third lecture because we're going to take that up exactly and the gentleman's point is that there are some species sorry some some human tribes on earth today that are living a stone age existence and his point is they don't seem to have gone through this accumulation of culture and knowledge and skills and technologies and he's right they haven't not nearly as much as as we have and we'll we'll see why that's the case in in the in the third lecture um suffice it to say that um what they don't do which is what all other animals do is recreate they don't recreate their culture every generation they pass down what knowledge they do have like what plants to eat how to make shelters and so on that's passed down from generation to generation the newborns don't have to re-learn every generation how to be that kind of person and we all know there's some teaching and the sorts of things in in other animals but to a first good first approximation all other animals their culture consists of what you can discover yourself in one generation they sort of recreate their entire culture every generation this is true of chimpanzees with sort of nut cracking and fishing for termites and so on so we'll get into that more so thank you for the plug we'll get into that more in the in the third lecture okay maybe one more if anybody really is desperate to ask one one more down here and then we'll finish off so language was a huge kickstart for our evolution and thanks to industrialization and formal education people are engaging in written language at a younger age than ever do you think our use of written language could kickstart another huge change in our evolution so the question is written language going to bring about another huge change in our evolution so the wonderful thing about written languages is it's completely foreign to our brains um we we have sculpted written language the way we've sculpted words but it's it's not what we evolved to do we just evolved to speak and to think about language so i think the answer to the question is yeah written language has already had an enormous influence on the human species because it is an extraordinarily high fidelity way of storing information right as soon as i learn how to get from point a to point b i can just come back and write it down that's not going to be forgotten especially if i scratch it out on some stone and you might laugh at that a little bit but for example some of the earliest written communication might have been aboriginal tribes actually scribbling out directions just like that in in the sand in in the red desert so yeah it will and it already it already has but whether it's going to lead to a change in our brains i don't know i don't know. so i think a lot of people would say that the hebrew thing is sort of made up right but i could see that this could be a a discussion that could go on for hours you've got to remember the bible itself isn't that old right and the people who believe the bible literally think that the history goes back what is it another 4 000 years beyond that so it really is a sort of non-starter in a way we just don't know



nobody i think is saying that hebrew was the mother tongue well the bible story if you take it literally is that there was a single language but the bible story wasn't that humans evolved 200 000 years ago it was that god created them i'm not a bible scholar four thousand or six thousand years ago of languages yeah but originally there was just one language no but you gotta just take this as a story it doesn't bear any truth well is the tower of bubble just a story then is that yeah it is it is a story, it's an illustrative.



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