The puzzle of language change

Language is constantly changing. This presents us with a puzzle: language change is functionally disadvantageous, in that it hinders communication, and it is also negatively evaluated by socially dominant groups. Nevertheless it is a universal characteristic of human language and, for the most part, cannot be stopped.

How and why does language change?

Changes can take origin from language learning, or through language contact, social differentiation, and natural processes in usage.

Language learning: the process of linguistic replication is imperfect, so that the result is variable across individuals.

- A bias in the learning process -- for instance, towards regularization of paradigms (e.g. the replacement of older *holp* by *helped*) -- can cause systematic drift, generation by generation.
- But frequently, the mutation of a language through imperfect learning is essentially random.

Language contact: in contact situations, languages often borrow words, sounds, constructions and so on.

Social differentiation: social groups adopt distinctive norms of dress, adornment, gesture and so forth; language is an important part of the package.

- Many instances of language change, especially those which differentiate one dialect or language from another, start out as markers of some social group.
- Sociolinguistic research has shown that all changes have a social dimension while they are in progress, with one social group or another leading the change and others following behind.

Natural processes in usage:

- Rapid or casual speech naturally produces processes such as assimilation (pronouncing neighboring sounds more like each other), dissimilation (pronouncing neighboring sounds less like each other), syncope (eliminating a vowel in the middle of a word) and apocope (eliminating a vowel at the end of the word).

Through repetition, particular cases may become conventionalized, and therefore produced even in slower or more careful speech.

- Certain changes arise from pressure to maintain a certain amount of symmetry in the linguistic system. This is especially the case in changes in vowel systems. If one vowel changes its pronunciation significantly, it often pulls the rest of the system with it.
• Word meanings can change in a similar way, through conventionalization of processes like metaphor and metonymy. E.g., meaning of trivial has gone from "pertaining to the trivium, the elementary areas of study" to "simple or easy to the point of being meaningless" via metaphor

But why?
E.g., why must language be learned at all? If we have a language instinct, as Pinker and Chomsky argue, then why aren't we just born knowing all of the details of language?

Then everyone would have the same language, we could all talk to each other, and children wouldn't have to spend so much time in their formative years learning to speak. Pinker argues that there are evolutionary reasons favoring the current situation -- where the blueprint for language is instinctive, but the details are learned.

This allows flexibility and extensibility, for example the creation of new words for new concepts. Also, it provides a way for people to sync up their languages in the case that, by some genetic mutation, their language instincts diverge somewhat.

Why the internal pressures of the system and for ease of articulation don't eventually push a language into some perfect state where pronunciation is as easy as possible, and the system is perfectly symmetrical?

Changes resulting from internal pressures actually seem to be a constant balancing act, an attempt to maintain an equilibrium that is being constantly disturbed by other changes.

The analogy with evolution via natural selection

Charles Darwin himself, in developing the concept of evolution of species via natural selection, made an analogy to the evolution of languages.

• At any given point in time within a population, there is a certain amount of variation, where some variants survive to the next generation and others are eliminated, the overall effect being a drift from some older set of characteristics defining the group to a newer set of somewhat different characteristics.

• In evolution, different species are formed at the point where individual members of the one population can no longer mate and breed successfully with an individual member of the other population. In linguistics, different languages are formed at the point where members of the two populations can no longer understand each other.

There are some key differences between grammars and genotypes:

• Linguistic traits can be acquired throughout one's life from many different sources, although initial acquisition and (to a lesser extent) adolescence seem to be crucial stages.

• Acquired (linguistic) traits can also be passed on to others.

• Linguistic history need not have the strict form of a tree, with languages splitting but never rejoining, whereas genetic evolution is largely constrained to have a tree-like form (despite the possibility of transfer of genetic material across species boundaries by viral infection and so on).

Practically, the assumption that linguistic history is a sort of tree structure has been found to be a good working approximation.
In particular, the basic sound structure and morphology of languages usually seems to "descend" via a tree-structured graph of inheritance, with regular, lawful relationships between the patterns of "parent" and "child" languages.

Types of Change

All aspects of language change. We can think about this in terms of changes in subparts or modules of the grammar, in the syntax, phonology, semantics, morphology, and pragmatics.

Pragmatic shifting

A syntactic construction with a particular pragmatic function may acquire a new function over time. For instance, many languages have impersonal pronouns that start out as nouns meaning “person” E.g., English one and French on from Latin homo=“person”; German man from German mann=“man”). Eventually they come to be used in generic contexts, like

One is always uneasy in such situations
One should take care of one’s parents

In some languages, the function of these pronouns expands even further – they are also used in episodic/non-generic contexts with a sort of passive meaning:

French On a tué le président = ON has killed the president = The president was killed
German Man hat ein Haus abgebrannt = MAN has burned a house = A house was burned.

Eventually, these constructions may encroach on the actual passive so much that the passive will go out of use entirely. In this way, pragmatic change sometimes leads to syntactic change.

Semantic drift

Semantic changes usually take the form of drift in the meaning of a particular word, sometimes randomly, but usually on a roughly metaphoric path, like that of trivial described above.

Because such changes affect specific words rather than larger grammatical classes, they are usually not terribly systematic. That is, while we can talk about types of semantic change that are more or less likely, we cannot usually make broad statements about semantic changes within a given language.

Syntactic change

The structure of sentences within a language changes over time. E.g., a number of European languages have gone from being primarily SOV to being SVO during their recorded histories, including English and the Romance languages.

E.g., (a) below, taken from the early Old English poem Beowulf, has the verbs at the end of the clause, where the modern English translation in (b) has them in the middle:
a) ac he sigewæpnum forsworen hæfde
b) but he had forsworn (put a spell on) the victory-weapons

Syntactic changes of this sort are a good deal more systematic than semantic changes, because they affect not specific sentences, but entire rules of the grammar.

**Sound change**
The biggest success story in historical linguistics (and perhaps in linguistics in general) is in our understanding of sound change, i.e. the ways that pronunciations and phonological systems change over time.

Why? High-quality research on this area has been going on for well over a century, since the work of Sir William Jones mentioned in the PBS video

Also because of the nature of sound change itself.

- Sound changes are remarkably regular: generally they do not affect individual words, but phonological systems.

In the example discussed in the video, speakers in Philadelphia haven't just started pronouncing out more like [eot], they have started pronouncing the sound /aw/ like [eo] everywhere it occurs.

**Unconditional sound change:** an old sound becomes a new sound across the board, in every phonological environment.

E.g., a change between Middle and Early Modern English (around Shakespeare's time) is the upheaval known as the **Great Vowel Shift**.

In earlier stages of English, there was a **length distinction** in the English vowels, and the Great Vowel Shift altered the **position** of all the long vowels, in a giant rotation.

- The nucleus of the two high vowels (front "long i" /i:/, and the back "long u" /u:/) started to drop, and the high position was retained only in the offglide. Eventually, the original /i:/ became /ay/ -
  - so a "long i" vowel in Modern English is now pronounced /ay/ as in a word like 'bite': /bait/.
  - Similarly, the "long u" found its nucleus dropping all the way to /au/: the earlier 'house' /hu:s/ became /haus/.
- All the other long vowels rotated, the mid vowels /e:/ and /o:/ rising to fill the spots vacated by the former /i:/ and /u:/ respectively, and so on.
  - That is why the modern pronouns 'he' and 'she' are written with /e/ (reflecting the old pronunciation) but pronounced as /i/.

In the following chart, the words are located where their vowel used to be pronounced -- where they are pronounced today is indicated by the arrows.

**The Great Vowel Shift (1450-1700)**

![Diagram of the Great Vowel Shift](image-url)
**Conditioned sound change:** a sound change may be "conditioned" so as to apply in certain kinds of environments and not in others.

E.g., flapping of /t/ and /d/ in American English which we discussed before. Earlier, all instances of /t/ were essentially the same, similarly for /d/. Now, /t/ and /d/ sometimes pronounced as [ɾ], but not for every instance of /t/ and /d/.

Rather, this change has only occurred when the sound is before an unstressed vowel in non-word-initial position. Note, crucially, that while such a change is not across the board, it is nonetheless completely regular according to rules that can be formulated in purely phonological terms. This is the power of sound change.

In the 18th century it was first recognized that Sanskrit, the ancient sacred language of India, must somehow be related to the classical languages of Europe, including Greek, Latin and Gothic among others.

As scholars began to compare the languages in detail, they found that they could make broad statements about correspondances between the languages.

E.g., Jacob Grimm, following a Danish linguist named Rasmus Rask, noted that the Germanic languages (including German, Dutch, English, Norse and the extinct language Gothic) tended to have fricatives where the other languages had voiceless stops:

<table>
<thead>
<tr>
<th>English=Germanic</th>
<th>Latin=non-Germanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>father</td>
<td>pater</td>
</tr>
<tr>
<td>three</td>
<td>tre:s</td>
</tr>
<tr>
<td>hund(red)</td>
<td>centum</td>
</tr>
</tbody>
</table>

On this basis, it was possible to formulate sound correspondances between languages, and to theorize the sound changes that might have led to the differences.

Grimm's Law: Indo-European *p -> Germanic *f and so forth, OR *voiceless stop -> fricative

(We use * to mark forms that are not attested anywhere, but have been reconstructed for some pre-historic period. That is, on the basis of what we know about certain attested languages, we hypothesize a form for their parent language. Do not confuse this with the * which markes ungrammaticality!)

It was originally thought that these expressed tendencies, not absolute rules, because a certain number of exceptions could be found, like the following:

<table>
<thead>
<tr>
<th>English or Gothic = Germanic</th>
<th>Latin = non-Germanic</th>
</tr>
</thead>
</table>

5
In the first two words we have a voiceless stop in the Germanic words just like in the Latin word.
In the second two we have a voiced stop. In both instances we would have expected, on the basis of Grimm's Law, to have a voiceless fricative.

However, it was discovered in the late 19th century that the apparent exceptions to Grimm's Law fall into phonologically-defined classes.
So the first two above happen to follow /s/, and indeed in all instances where an Indo-European stop followed an s, it remained a stop rather than becoming a fricative.
This is not surprising if we think about what happens to stops after /s/ in Modern English.

With the other two examples, in the original language, the word stress was on the syllable following the voiceless stop.
E.g., the Sanskrit word for "father" is pitá, and the Greek word is paté:r.
Similarly, the participle had stress on the suffix, not the stem.
Indeed, it turns out that all non-initial /p,t,k/ which were followed by a stressed syllable came out as /b,d,g/ in the Germanic languages rather than /f,θ,x/.

Grimm's Law was thus reformulated by a linguist named Verner (and thus is now sometimes called Verner's Law), as a conditioned but exceptionless change.

**Verner’s modifications:**
\[ p \rightarrow p / s \]  
\[ p \rightarrow b / P_\sigma \]  \( (P = \text{phoneme}, \sigma = \text{syllable} \; \dot{\sigma} = \text{stress}) \)
\[ p \rightarrow f \; \text{otherwise} \]

or,
voiceless stop \( \rightarrow \) unchanged \( / s \)  
voiceless stop \( \rightarrow \) voiced \( / P_\sigma \)  
voiceless stop \( \rightarrow \) fricative \( \text{otherwise} \)

At around the same time, a series of sound changes were understood in this way, with their exceptions being eliminated by more detailed formulation of the phonological environment.

The linguists of this era called themselves the Junggrammatiker or Neo-Grammarians, and proposed the theory that all sound change is regular.

**Processes of sound change.**

Sound changes can be classified according to the particular process involved.
Assimilation, or the influence of one sound on an adjacent sound, is perhaps the most pervasive process. E.g. pronunciation of the prefix in-

In contrast to assimilation, **dissimilation, metathesis, and haplology** tend to occur more sporadically, i.e., to affect individual words.

**Dissimilation** involves a change in one of two 'similar' sounds that are adjacent or almost adjacent in a particular word to make them less similar: mainly affects /l/ and /r/.

**Metathesis** involves the change in order of two adjacent sounds. E.g. Modern English *third* is from OE *thrid* Modern English *bright* from OE *beorht* But this is not a regular sound change. Not all "vowel + r" words changed the relative order of these segments, and sometimes we get variation in a single word. Already by the time of Old English, there were two forms of the word for "ask": *ascian* and *acsian*. We don't know which form was metathesized from the other, but we do know that *ascian* won out in the standard, while the descendent of *acsian* lives on in many non-standard dialects.

**Haplology** is similar to dissimilation, because it involves getting rid of similar neighboring sounds, but this time, one sound is simply dropped out.

Other sound change processes are **merger, split, loss, syncope, apocope, prothesis, and epenthesis**.

**Merger** and **split** can be seen as the mirror image of each other. A merger that is currently expanding over much of the United States is the converging pronunciations between "short o" and "long open o" in words like *cot* and *caught*.

Splits are more rare than mergers, and usually arise when a formerly conditioned alternation loses the environment that provided the original conditioning, and the previously conditioned alternation becomes two independent sounds that contrast with each other. E.g., /f/ and /v/ split in English (/v/ having previously been an alternate of /f/ when /f/ occurred in an intervocalic position). Plurals like loaves and leaves to loaf and leaf are reflexes of this old alternation.

**Loss** involves the loss of a sound from a language, as when English lost the velar fricative [x] (like the ch in German Bach, still written in some words as gh (e.g. bright, night, rough)).

**Syncope** and **apocope** are the loss of medial and final sounds respectively. E.g., Middle English 'tame' in the past tense was /temede/. It lost both its medial and final vowels to become Modern English /teymd/.

These are usually conditioned changes that do not involve loss of the same sound elsewhere.

**Prothesis** and **epenthesis** are the introduction of additional sounds, initially and medially respectively. E.g., prothesis of the /e/ that made Latin words like *scola* 'school' into Portuguese *escola*.

epenthesis of /d/ in English into ME *thunrian* to give us the Modern English *thunder*, or the short vowel inserted in front of the inflectional suffixes -s and -d when they follow similar sounds.
| Assimilation | in → in / _ alveolar C | in / __V | in → in / __ velar C | in → in / __ bilabial C | intractable | ineligible | uncredible | impossible |
| Dissimilation | first /l/ in colonel is changed to [r] |
| Metathesis | ME third is from OE thrid ascian ME bright from OE beorht ascian |
| Haplology | probably → prob’ly |
| Merger | a, o → a (roughly) | cot, caught |
| Split | Earlier: f → v / V__V Now: f, v different phonemes | loaves, leaves |
| Loss | English lost velar fricative x | Bach/bright, rough |
| Syncope | P → 0 / P__P | MiE /temede/ |
| Apocope | P → 0 /__# | MoE /teymd/ |
| Prothesis | Insertion of /e/ Latin scola → Portuguese escole |
| Epenthesis | MiE thunrian → MoE thunder -s → as / sibilant -d → ad / alveolar stop |

**Language change and historical reconstruction**

- It was mentioned above that one of the motivations for language change is the pressure to maintain a symmetrical system. What does this mean?
  
  E.g., the vowel system of a language goes through some sort of adjustment to maximize the differences between the various vowels, to avoid misunderstandings

- The techniques that have been developed to deal with sound change, combined with certain important assumptions, permit us to reconstruct the sound system -- and some of the vocabulary -- of unattested parent languages from information about daughter languages.

  E.g., from Gothic, Greek and Sanskrit forms for father + knowledge about what sorts of sound changes are likely: “father” in the ancestor of all of these languages was something like *pxtér.

  A great deal of the phonology, morphology, vocabulary and syntax of this language, which we call Proto-Indo-European, has been reconstructed, and we can be confident that our reconstructions are fairly accurate, even though PIE was spoken about 6,000 years ago and has no written legacy.

**Analogy**

This is most frequently a morphological change, where the inherited form for some category is replaced by a form which has been extended from some slightly different category. Usually, this is the way in which irregularities are levelled out.
E.g. *helped* from *holp*. The ending -ed was extended to this verb on analogy with other regular verbs in the language, like *played* and *worked*.

**How do we know how languages are related?**
Linguists rely on the regularity of sound changes to reconstruct the common ancestor of languages they know to be related to one another. They also rely on this to establish in the first place that two or more languages are related and how the relationships work.

In order to figure out whether two languages are related, we attempt set up regular sound correspondences between them. That is, we look for pairs of words that look like cognates, i.e. words that descend from a common word in an ancestral language, and we figure out whether there are consistent patterns of one sound in language A corresponding to one sound in language B.

This can be easily done for English and German, two fairly closely related languages. In fact a great number of specific correspondences can be listed, but for brevity I will restrict attention here to some of the initial consonants.

So at the beginning of a word, the English stop /p/ corresponds to the German affricate /pf/.

- path → Pfad
- pan → Pfanne
- pepper → Pfeffer
- pipe → Pfeiffe
- plant → Pflanze
- plum → Pflaume

Corresponding to English /t/ word-initially, German has the affricate /ts/, written as z.

- tame → zahm
- to → zu
- tongue → Zunge
- ten → zehn
- twenty → zwanzig
- tin → Zinn

Initial /d/ in English corresponds to German /t/:

- day → Tag
- dance → tanzen
- dew → Ta
- devil → Teufel
- drink → trinken
- do → tun

And finally, initial English /θ/ correspond to German /d/:

- that → das
- thick → dick
- thin → dünn
- thirst → Durst
- three → drei
- though → doch

If we can set up sound correspondences like these for a pair of languages, then we can reasonably say that they must be related, in the sense of being descended from a common ancestor. This is because the probability of such consistent and extensive patterns arising either by chance or due to borrowing from one language into the other are vanishingly small.
Once we have correspondences like this, we can try to figure out the original sound and the sound changes that derived the attested sounds from it in each language.

We can also use this method to figure out interrelationships within the larger group.

- When a change occurs within a speech community, it gets diffused across the entire community of speakers of the language.
- If, however, two communities have split and are no longer in contact, a change that happens in one community will not get diffused to the other community.

E.g., changes that happened between early and late Latin show up in all the 'daughter' languages of Latin, but once the late Latin speakers of the Iberian peninsula were no longer in contact with other late Latin speakers, changes there would not spread to the other communities.

- Languages that share innovations are considered to have shared a common history apart from other languages, and are put on the same branch of the language family tree.

E.g., English, German and Gothic are all Germanic languages – they all have /f/ as the first sound in words meaning "father", "five" and "for", unlike the other IE languages, which have a /p/ in this position (cf. Greek pater, pente, pro:).

The sound change *p > *f is a shared innovation of the Germanic languages.

Further, German and English form a group to the exclusion of Gothic because, e.g., they have /r/ sounds where Gothic preserves the older Germanic /z/, as in English more and German mehr vs. Gothic maiza.

The sound change *z > *r is a shared innovation of the West Germanic languages.

Further, the Bavarian and Alemannic dialects of modern German (which are not mutually intelligible) belong to a group that excludes English because they have the velar fricative /x/ where English has the older /k/, as in Bav. mocha, Alem. mache vs. English make.

So the sound change *k > ch is a shared innovation of the so-called High German dialects.

In other words, we can tell not only which languages are related, but how a group of related languages fits together in a family tree.

Try it on the several cognate sets in five languages of the Polynesian family listed here.

<table>
<thead>
<tr>
<th>English</th>
<th>Tongan</th>
<th>Maori</th>
<th>Samoan</th>
<th>Tahitian</th>
<th>Hawai’ian</th>
</tr>
</thead>
<tbody>
<tr>
<td>bird</td>
<td>manu</td>
<td>manu</td>
<td>manu</td>
<td>manu</td>
<td>manu</td>
</tr>
<tr>
<td>fish</td>
<td>ika</td>
<td>ika</td>
<td>iʔa</td>
<td>iʔa</td>
<td>iʔa</td>
</tr>
<tr>
<td>to eat</td>
<td>kai</td>
<td>kai</td>
<td>ʔai</td>
<td>ʔai</td>
<td>ʔai</td>
</tr>
<tr>
<td>forbidden</td>
<td>tapu</td>
<td>tapu</td>
<td>tapu</td>
<td>tapu</td>
<td>kapu</td>
</tr>
<tr>
<td>eye</td>
<td>mata</td>
<td>mata</td>
<td>mata</td>
<td>mata</td>
<td>maka</td>
</tr>
<tr>
<td>blood</td>
<td>toto</td>
<td>toto</td>
<td>toto</td>
<td>toto</td>
<td>koko</td>
</tr>
</tbody>
</table>
• No changes happened in the nasal consonants or in the vowels, i.e. all the languages agree.
• But we can observe in lines 2 and 3 that wherever Tongan and Maori have /k/, Samoan, Tahitian and Hawai'ian have /ʔ/ (glottal stop).

Apparently there has been an unconditioned change from /k/ to /ʔ/ in the Eastern branch, or a change from /ʔ/ to /k/ in the Western branch of this family.

We choose the first as more likely

  o partly because backing of consonants is more common than fronting (we can think of examples of just this change happening elsewhere, e.g. in Cockney English), and
  o partly because of what we know about the culture history: Polynesia was peopled from west to east, so there was no time when the Western speakers were all in one place without the Easterners.

• Next, in lines 4 - 6 that there is a systematic correspondence between /t/ in the first four languages and /k/ in the easternmost, Hawai'ian. This looks like another systematic, unconditioned sound change, this time in only one language.

This is what a family tree of the five Polynesian languages would look like, based on the small data set above (the picture is somewhat more complex when we look at other cognate sets):
How far back can we go?

- Our methods of reconstructing earlier forms of language are at base little more than educated guesses.
  - Because not all language change is sound change, and certain irregularities creep in, every stage of reconstruction is bound to have a small number of errors.
  - Thus the further back we go, the less certain we can be of our guesses.

- Most linguists agree that our methods for reconstruction will take us only as far back as about 5000 - 7000 years
  - After that, the number of cognate sets available for reconstruction becomes just too low to give results that can be reliably distinguished from chance relationships.
  - Although it would be very satisfying to be able to link up some of the existing families at a higher level, the evidence seems too weak to allow us to do so.

- A minority of scholars, however, argue that this is possible, and one particularly well-known group of such scholars goes by the name of Nostraticists, derived from their views that there exists a super-family of languages they have called the "Nostratic".
  - A New York Times article from 1995 presents a well-balanced view of the Nostraticist position.
  - Dr. Donald Ringe whom you saw in the video, an expert on the ancient Indo-European language Tocharian and one of the world's leading Indo-Europeanists, is one of the chief critics of the Nostraticist position.

What are the results of language change?

When accompanied by splits of populations, language change results first in dialect divergence (the kinds of differences we see between British and American English; between the French of France and of Quebec; between New World and Old World Spanish and Portuguese).

Initial problems with intelligibility begin long before we would consider talking about separate languages. Indeed, certain systematic comprehension difficulties can occur even within relatively closely related dialects.

In one example alluded to in the PBS video by Professor William Labov, the following phrases taken from the spontaneous speech of Chicagoans recorded in the early 1990s were difficult for many non-Chicagoans to understand correctly out of context.

In "gating" experiments designed to test cross-dialectal comprehension in American English, people first heard a word by itself, then a slightly longer segment, then a whole phrase or sentence that may have disambiguated the original mishearing.

(For more info on this vowel change called the Northern Cities Shift, see "The Organization of Dialect Diversity" on the home page of the Phonological Atlas of North America.)
<table>
<thead>
<tr>
<th>Original segment</th>
<th>Many people misheard as</th>
<th>First expansion</th>
<th>Second expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>drop</td>
<td>??? (nonsense word containing vowel in &quot;that&quot;)</td>
<td>massive drop</td>
<td>the plane was steady for a while and then it took a massive drop</td>
</tr>
<tr>
<td>socks</td>
<td>sacks</td>
<td>y'hadda wear socks</td>
<td>y'hadda wear socks, no sandals</td>
</tr>
<tr>
<td>block</td>
<td>black</td>
<td>one block</td>
<td>old senior citizens living on one block</td>
</tr>
<tr>
<td>met</td>
<td>mutt</td>
<td>they met</td>
<td>my parents went to Cuba and that's where they met</td>
</tr>
<tr>
<td>steady</td>
<td>study</td>
<td>steady for a while</td>
<td>the plane was steady for a while and then it took a massive drop</td>
</tr>
<tr>
<td>head</td>
<td>had</td>
<td>shook 'er head</td>
<td>this woman in while, who just smiled at her and shook 'er head</td>
</tr>
</tbody>
</table>

These misunderstandings are based on the fact that the Chicago speakers (along with 40 - 50 million other people in the "Inland North" dialect including Rochester, Buffalo, Detroit, Syracuse, and other cities of that region) have a rotation of their short vowels such that the low unrounded vowel of the "short o" words like drop, socks, block, and hot is being fronted to the position where other American dialects have words like that, hat, black, rap, and sacks, and where "short e" words like met, steady and head can sound like mutt, study and thud or mat, static and had.

Over longer time periods, we see the emergence of separate languages, and, as alluded to above, when a group of languages all descend from a common parent, we call them a family. More on that in the next lecture!