ANIMALS, HUMANS, AND LANGUAGE
Anders Holmberg

One of the properties we have as humans which makes us different from other species is a capacity for acquiring and using a form of language which is far more complex than the language, or system of communication, of any other species. This capacity has been crucial for the evolution of human technology and human society, providing us with a huge advantage over other species. The advantage derives not just from the fact that human language is a superior instrument of communication between people, but it is also a superior instrument for the acquisition of knowledge and for storing knowledge, and importantly, it is an instrument for rational thought.

What is it exactly that makes human language so special, though? After all, animals, too, can communicate with each other, although the messages that they convey are generally speaking very limited in terms of their content, compared to the messages that we can convey using human language. Our language is richer and more complex than animal systems of communication, but the question is whether it is also qualitatively different, not just quantitatively different (more sounds, more words, more complex structures), from any means of communication that animals have at their disposal. The best way to find out is to compare human natural language to animal “languages”, i.e. systems of communication used by animals.

There are other species that have communication systems characterized by a certain degree of complexity, for instance, some songbirds, dolphins, monkeys and apes, and even some insects: honey bees can convey information to each other about the location of a source of nectar by moving their body in a certain pattern. Furthermore, we know that certain animals, although they don’t use a language with human characteristics under natural conditions, are capable of learning certain parts, or aspects, of human language, up to a certain level. For instance, some parrots can learn to imitate the sounds of human language with a very high degree of accuracy. And chimpanzees can learn to communicate with humans using what is basically human language. Since, due to physical limitations they can’t learn speech, what they learn is usually some form of sign language, but arguably they learn to use signs basically in the way that we humans do.

The purpose of this lecture is to try to determine what it is that makes human language, and human cognition, special in the living world. I will begin by comparing the language used by a trained chimp with the language used by a human child at a comparable level of intellectual maturity.

I will then consider the calls of the chickadees. The call of this American bird is known to have some formal properties which, in some sense, match those of human language.

Finally I will comment briefly on the dance of the honeybees, another famous form of animal communication.

Project Nim

One of the big questions within linguistics in the past fifty years is whether the capacity to learn and use human language as we know it is an innate, genetically
determined capacity specific to humans, and specific to language, or whether it is a consequence of general cognitive capacities (general intelligence), in conjunction with intensive learning. One way to find out, is to investigate whether non-human animals can learn something like human language if they are trained appropriately. In particular, we might like to know whether our closest relatives, the non-human primates, can be taught to communicate with us in something like human language. If an ape can attain the same level of linguistic competence as a human child of roughly comparable general intelligence, then this would indicate that language is not a capacity specific to our species.

In the sixties and seventies there was a flurry of projects where primates, particularly chimpanzees, were taught language. One of them was Project Nim. In this project, which started in 1973, a male, infant chimpanzee named Nim Chimpsky “became the sole student in a small classroom complex /.../ designed for him in the Psychology Department of Columbia University” (Terrace 1983: 22). When not in the classroom, he was living together with a family of people. In this classroom Nim was taught a pidgin version of American Sign Language (ASL). Non-human primates do not have a vocal apparatus which would allow them to imitate human speech; therefore they are taught some form of sign language. The project lasted 44 months.

What made this project different from the ones preceding it (such as the Washoe project, reported in Gardner & Gardner 1969), was that the entire process was observed, through a one-way window, recorded and videofilmed. It was known already that a chimpanzee can learn individual signs, and put them in sequences. What was not clear was whether those sign sequences, where they appeared to observe a fixed order, were learnt by imitating the human teachers, or whether they were the result of applying rules of grammar. Observing and videofilming the learning process would make it possible to tell. The purpose of the project, then, was to find out whether a chimpanzee can learn one or more rules of grammar.

In the 44 months that the project lasted (until Nim was 4 and a half years old), he learnt 125 signs. He also learnt to string signs together to form more complex expressions. The following table shows Nim’s most common two- and three-signs combinations, where the Frequency column shows how many times the particular sign-sequence was uttered.

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1 Nim was taught signs from ASL, but was not taught the grammar of ASL. Sign languages such as ASL, BSL (British Sign Language), etc. are fully-fledged languages with a grammar as complex as spoken languages.
Let us first focus on the two-word utterances. The following table shows a list of two word utterances from a human child. Children go through a period, normally when they are between 1 and a half and 2 years of age, when they utter sentences that are exactly two words long.

<table>
<thead>
<tr>
<th>Two-Sign Combinations</th>
<th>Frequency</th>
<th>Three-Sign Combinations</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>play me</td>
<td>375</td>
<td>play me Nim</td>
<td>81</td>
</tr>
<tr>
<td>me Nim</td>
<td>328</td>
<td>eat me Nim</td>
<td>48</td>
</tr>
<tr>
<td>tickle me</td>
<td>316</td>
<td>eat Nim eat</td>
<td>46</td>
</tr>
<tr>
<td>eat Nim</td>
<td>302</td>
<td>tickle me Nim</td>
<td>44</td>
</tr>
<tr>
<td>more eat</td>
<td>287</td>
<td>grape eat Nim</td>
<td>37</td>
</tr>
<tr>
<td>me eat</td>
<td>237</td>
<td>banana Nim eat</td>
<td>33</td>
</tr>
<tr>
<td>Nim eat</td>
<td>209</td>
<td>Nim me eat</td>
<td>27</td>
</tr>
<tr>
<td>finish hug</td>
<td>187</td>
<td>banana eat Nim</td>
<td>26</td>
</tr>
<tr>
<td>drink Nim</td>
<td>143</td>
<td>eat me eat</td>
<td>22</td>
</tr>
<tr>
<td>more tickle</td>
<td>136</td>
<td>me Nim eat</td>
<td>21</td>
</tr>
<tr>
<td>sorry hug</td>
<td>123</td>
<td>hug me Nim</td>
<td>20</td>
</tr>
<tr>
<td>tickle Nim</td>
<td>107</td>
<td>yogurt Nim eat</td>
<td>20</td>
</tr>
<tr>
<td>hug Nim</td>
<td>106</td>
<td>me more eat</td>
<td>19</td>
</tr>
<tr>
<td>more drink</td>
<td>99</td>
<td>more eat Nim</td>
<td>19</td>
</tr>
<tr>
<td>eat drink</td>
<td>98</td>
<td>finish hug Nim</td>
<td>18</td>
</tr>
<tr>
<td>banana me</td>
<td>97</td>
<td>banana me eat</td>
<td>17</td>
</tr>
<tr>
<td>Nim me</td>
<td>89</td>
<td>Nim eat Nim</td>
<td>17</td>
</tr>
<tr>
<td>sweet Nim</td>
<td>85</td>
<td>tickle me tickle</td>
<td>17</td>
</tr>
<tr>
<td>me play</td>
<td>81</td>
<td>apple me eat</td>
<td>15</td>
</tr>
<tr>
<td>gum eat</td>
<td>79</td>
<td>eat Nim me</td>
<td>15</td>
</tr>
<tr>
<td>tea drink</td>
<td>77</td>
<td>give me eat</td>
<td>15</td>
</tr>
<tr>
<td>grape eat</td>
<td>74</td>
<td>nut Nim nut</td>
<td>15</td>
</tr>
<tr>
<td>hug me</td>
<td>74</td>
<td>drink me Nim</td>
<td>14</td>
</tr>
<tr>
<td>banana Nim</td>
<td>73</td>
<td>hug Nim hug</td>
<td>14</td>
</tr>
<tr>
<td>in pants</td>
<td>70</td>
<td>play me play</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sweet Nim sweet</td>
<td>14</td>
</tr>
</tbody>
</table>
When we consider Nim’s two word utterances, there are some indications that the words are not just strung together randomly. In particular the combination of more with another word occurred in that order, more X, much more often than in the reverse order. Also the order Verb X was significantly more common than X Verb. For example give X, with a variety of object names in place of X, was considerably more common than X give. Terrace (1983, 1987) discusses the possibility that this is not really the application of a rule, but simply imitation of the teachers’ sign order. However, the give X example is evidence against the imitation hypothesis, since Nim started to say give X long before the teachers asked him to give them anything. That is to say, it looks like he was using the linguistic knowledge he had acquired, the signs with their meaning, in a creative way, to produce new messages according to rules, albeit quite elementary rules. This was the conclusion that Terrace reached.

On the other hand, the fact that reversal of word order with no change in meaning does occur among Nim’s utterances makes Nim’s signing different from that of human children. With human children two word utterances quite consistently follow the word order rules of adult language: For English children the subject precedes the verb (Joe see, Daddy run, Truck table, Joe push), and the verb precedes the object (Want cookie, Push cat, Give candy), possessive pronoun precedes the noun (My cup, Mommy chair), the question word is initial (Where doll?) etc. In fact, in the large majority of cases the two word utterances look like elliptical, ‘abbreviated’ versions of the corresponding adult sentences (Ingram, 1989).

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**Table 1: Two-word child utterances and their semantic analysis**

<table>
<thead>
<tr>
<th>Child utterance</th>
<th>Mature speaker utterance</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Want cookie.</td>
<td>I want a cookie.</td>
<td>Request</td>
</tr>
<tr>
<td>(B) More milk.</td>
<td>I want some more milk.</td>
<td>Request</td>
</tr>
<tr>
<td>(C) Joe see.</td>
<td>I (Joe) see you.</td>
<td>Informing</td>
</tr>
<tr>
<td>(D) My cup.</td>
<td>This is my cup.</td>
<td>Warning</td>
</tr>
<tr>
<td>(E) Mommy chair.</td>
<td>This chair belongs to Mommy.</td>
<td>Answer to Question</td>
</tr>
<tr>
<td>(F) Mommy chair.</td>
<td>This chair belongs to Mommy.</td>
<td>Answer to Question</td>
</tr>
<tr>
<td>(G) Mommy chair.</td>
<td>Mommy is sitting in the chair.</td>
<td></td>
</tr>
<tr>
<td>(H) Big boy.</td>
<td>I am a big boy.</td>
<td>Bragging</td>
</tr>
<tr>
<td>(I) Red car.</td>
<td>That car is red.</td>
<td>Naming</td>
</tr>
<tr>
<td>(J) That car.</td>
<td>That is a car.</td>
<td>Naming</td>
</tr>
<tr>
<td>(K) No sleep.</td>
<td>I don't want to go to sleep.</td>
<td>Refusal</td>
</tr>
<tr>
<td>(L) Not tired.</td>
<td>I am not tired.</td>
<td>Refusal</td>
</tr>
<tr>
<td>(M) Where doll?</td>
<td>Where is the doll?</td>
<td>Question</td>
</tr>
<tr>
<td>(N) Truck table.</td>
<td>The truck is on the table.</td>
<td>Informing</td>
</tr>
<tr>
<td>(O) Daddy run.</td>
<td>Daddy is running.</td>
<td>Informing</td>
</tr>
<tr>
<td>(P) Joe push.</td>
<td>I (Joe) pushed the cat.</td>
<td>Informing</td>
</tr>
<tr>
<td>(Q) Push cat.</td>
<td>I pushed the cat.</td>
<td>Informing</td>
</tr>
<tr>
<td>(R) Give candy.</td>
<td>Give me the candy.</td>
<td>Request</td>
</tr>
</tbody>
</table>
The fact that they don't always look like elliptical versions of adult sentences is also an important observation, though, as it is indisputable evidence that children actually construct sentences of their own, and do not just imitate those that they have heard older people say. Examples are two-word sentences like No sleep to mean ‘I don’t want to sleep’.

The most striking difference between Nim and human children emerges when we consider three word utterances. Consider the following three–word utterances by Cecile, a human child.²

**Utterances from Cecile, age 20 months**

1. Eva stamp balloon. (= Eva stamped on a balloon)
2. Eva balloon bang.
3. Eva stamp balloon bang.
5. Ants bite you. *(Here, she’s copying adults saying ‘Ants might bite you.’)*
7. Nick tickle you. (= Nick tickled me.)
8. Nina bounce trampoline. (= Nina bounced on the trampoline)
9. Cecile shopping Gran. (= I’m [playing at] going shopping with Gran)

The word order is completely consistent: Apart from sentence 2, the sentences consist of a noun followed by verb followed by a noun or pronoun. Furthermore, the **grammatical function** of the nouns/pronouns have a systematic relation to the word order: The initial noun is the subject, the postverbal noun/pronoun is the object or an adverbial. This reflects the word order of English adult sentences, where the subject likewise precedes the verb while objects and the relevant types of adverbials follow the verb. Notions such as subject, object, and adverbial are structural notions; The object has a different structural relation to the verb than the subject has.

That the sentences have syntactic structure is especially evident in sentence 2. It translates into adult English roughly as ‘Eva’s balloon went bang.’ That is to say, the initial two words form a noun phrase, which is then combined with the word bang. The noun phrase functions as subject, the word bang as predicate. The sentence is clearly not just three words strung together in a sequence: It has syntactic structure.

Nim’s three word sentences are different. They do not appear to have any structure. In fact, the three word sentences look like the two word sentences with a redundant word thrown in, usually repeating one of the two other words. The third word does not enrich the semantic or conceptual content of the sentence (it does not add a new concept), but merely adds emphasis, if it does anything at all.

As discussed by Terrace, in terms of syntactic/semantic complexity, Nim’s sentences never progressed beyond the two word stage, with its few elementary rules (which were not even consistently applied). All utterances longer than two words have the same character as the three word sentences: The additional words add nothing to the content of the message other than, possibly, some sort of emphasis, or insistence, or urgency. Furthermore, they seem to occur in random order, as seen in the following table.

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²Thanks to Heather Marsden for collecting these sentences.
Compare this with some of Cecile’s longer-than-3-words utterances.

**Complex utterances by Cecile:**
1. Mummy going see with jamas on. (= Mummy’s going to see me when I’ve got my pyjamas on.)
2. Take that off go play in lounge. (= I want to take off my bib and go and play in the lounge.)

Summing up, like other chimpanzees and bonobos\(^3\) that have been trained by human teachers, Nim was able to learn a fairly extensive vocabulary. However, what he did not acquire was the grammar (the syntax) by which the words are combined into complex, structured messages, apart from some quite elementary word order rules, which were not even applied consistently.

Nim’s learnt language has certain other properties which are strikingly different from the language of two-year old human children. Practically all of his utterances were requests for items or favours from his human interlocutors. Human children obviously also request items or activities, but they do much more than that: They comment on their own activities, and other people’s activities, and on properties of objects, and they ask questions.

\(^3\)Bonobos were earlier considered to be a variety of chimpanzees, but are now considered a separate species. They are, apparently, even more intelligent than chimpanzees; Savage-Rumbaugh & al. 1993.
Bird communication: Chickadee calls

The chickadees are American birds belonging to the family of tits (Parus). Some of the chickadee species have a call (the “chick-a-dee call” which has given them their name) which is known to be complex, in an interesting way, being a manifestly combinatorial system of communication, and similar in that respect to human language (Hailman & al. 1987). Being manifestly combinatorial means that the call is made up of a small set of discrete sounds (note-types) which are combined in a systematic fashion, according to certain rules, to produce a large set of expressions (call-types).

The black-capped chickadee (Poecile atricapillus or Parus atricapillus)^4, for example, uses four note-types to produce hundreds of different call-types. The note-types appear in a fixed order, and in any given call a note-type may be omitted, uttered once, or repeated a variable number of times. The result is a large repertoire of different call-types. Their communication system therefore appears analogous to human language. It is typical of human language that a small set of discrete units are combined according to certain rules, so as to yield a large set, in fact an infinitely large set of expressions. Thus a small set of of speech sounds are combined to yield a set of words, in principle infinitely large (since new words can always be added). And a not so small, but at least finite, set of words can be combined to yield an infinite variety of sentences. Arguably the chickadee calls have this property as well.

The four note types are called A, B, C, and D. An A-note is usually followed by another A-note (i.e. a repetition of itself) or by a D-note. B is usually followed by another B-note or by C, which is again followed by another C-note or by D. Finally a D-note can only be followed by another D-note or by silence. The call could also end after any other note. The following is a sample of common calls:

(1) AA
    AD
    AAAD
    AADDD
    BCD
    BD
    BBBD
    BDDD
    BBCCD
    CDD

Strings where A was followed by B or C also occur, but more rarely.

(2) ABC
    AACC

But strings where a B would precede an A, or a C would precede a B or an A, or a D precede any other note basically never occur. In this sense the following combinations are ungrammatical as chickadee calls; the * means that the string is ungrammatical.

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^4 The American black-capped chickadee is a close relative of the European willow tit (Parus montanus).
This can be formalized as a rule:

\[
(A^n \rightarrow B^n \rightarrow C^n \rightarrow D^n, \text{ where } n \text{ is any number equal to or bigger than } 0.)
\]

The symbol \( \rightarrow \) means ‘is followed by’. That is to say, each note can be left out, uttered once, or repeated any number of times (in principle; in practice the calls were never longer than 24 notes), but they always occur in this order. That is to say the calls are formed according to a grammar, formally a so called finite state grammar. This means that, at any given step (or 'state') in the production of a string of symbols (here, note-types), the transition to the next state \( S+1 \) is completely determined by \( S \). For instance, when the chickadee call has reached note \( C \), the next step is completely determined by that fact: It can be zero (if the call stops at this point), \( C \) (if the \( C \)-note is repeated), or \( D \). No other properties of the string, such as which notes precede \( C \) have any effect on the step following \( C \).

So how does this compare with human language?

Human speech is made up of speech sounds, vowels and consonants, which are generally classified and systematized as a set of so called phonemes, such as \([i],[u],[k],[s],[l],[m]\), etc., where the precise composition of the set varies to some extent from language to language. The phonemes can be combined into strings of sounds, according to certain rules. In English, for example, the strings in (4) are well formed; they actually occur as words, or they don’t occur, but are nevertheless possible words of English, as is evident when compared with the strings in (5), which are not even possible as words of English:

(4) \[
\text{s k i l l} \\
\text{s i l k} \\
\text{l i k s} \\
\text{i l k s} \\
\text{k l i s}
\]

(5) \[
*\text{k s i l l} \\
*\text{l k i s} \\
*\text{i s l k}
\]

The strings in (5) violate the rules of English phonology, the phonotactic rules, so called. The case looks similar to that of the chickadee calls: Given a certain phoneme, there are constraints on which phoneme can be the next in line. For instance, if the word begins with a /l/, the next phoneme has to be a vowel, and if the word begins with /k/ the next phoneme must be either /l/, /t/, /w/, or a vowel. In fact the phonotactic rules are more intricate than the rules of the chickadee call, though. To begin with, there is an intermediate level between the phonemes and the level of words, namely the syllable; phonemes are arranged into syllables, which are then arranged into words. The phonotactic rules are sensitive to the position of the phoneme in the syllable. For instance, /l/ can very well be followed by a consonant.
provided /l/ is not in the initial, prevocalic part (the so called onset) of the syllable; while */lki/ is bad, /ilk/ is a perfectly fine English word. This means that English words cannot be generated by a rule, or rules, of as simple a format as (4). Since, as far as we know, all human languages make use of syllables, this is true of all human languages.

What if we consider the level of meaning as well? The phonemes are combined to eventually form words, or more precisely, to form morphemes, the minimal meaningful units of language. Some morphemes are words, others have to be combined with other morphemes to form words.

(6) tree, girl, and, if, will, the, -ed, -ing, -s, un-, -ness, etc.

Examples of -ed are painted, wasted; examples of –ing are running, stealing; examples of -s are books, flowers; examples of un- are unmarried, untrue, examples of –ness are greatness, blackness. The morphemes can be combined into complex expressions, according to certain rules. The rules which combine morphemes into complex words are the rules of morphology (or word formation), forming untrue, blackness, repayment, disappointment, football, saucepan, fast-talking, etc. etc. The rules which combine words into phrases and sentences are the rules of syntax. The strings in (7) observe these rules; note that some of the combinations may have a meaning which is bizarre and unusual, but they do observe the rules of English syntax, which is evident when they are compared with strings such as those in (8) which violate these rules.

(7) the girl planted tropical trees
    tropical girls planted the tree
    the tree planted tropical girls

(8) *the girl tropical trees planted
    *girl tree the planted tropical -s
    *plant trees tropical-ed the girl

The rules of word formation and the rules of syntax are clearly more intricate than the rules of the chickadee calls. However, if we carefully select a small set of words of, for example, English, we may formulate rules for how to combine those words that look like the chickadee call rule (4). For instance, considering just the words the, tropical, and tree, the following rule would express the fact that the only well formed multiword expressions that can be formed from these three words are the tree and the tropical tree. Any other order will be ill-formed.

(9) the → (tropical) → tree

This is not the way syntactic rules are generally formulated, though. To start with, the rules don’t apply to individual words, but to syntactic categories such as nouns, adjectives, determiners, verbs, etc. Furthermore, syntactic rules do not just combine words (or syntactic categories) into strings, but combine them to form complex, hierarchically structured expressions: syntactic categories are combined into minimal phrases, which are then combined into larger phrases, which are combined into even larger phrases, etc. One effect of this is that although the tree may be followed by a verb, as in

(10) the tree fell
it can do this only provided the tree is not also preceded by a verb.

(11)  *planted the tree fell

Why? A determiner and a noun form a noun phrase (NP), which can combine with a verb provided the NP is a subject, as in the sentence The tree fell. But if the NP is preceded by a transitive verb such as plant, the verb and the NP form a verb phrase (VP), and a VP cannot combine with another verb. Such constraints on the combination of categories are characteristic of a grammar with hierarchic structure. They cannot be modelled by a finite state grammar, but require a grammar which is computationally more powerful. The chickadee calls lack hierarchic structure. Nim’s more-than-two-word utterances also lacked hierarchical structure.

This, it seems, is a qualitative difference between at least these two examples of relatively sophisticated animal communication systems and human language. There are other differences, though, particularly if we consider chickadee calls.

Expressions of human language have a meaning; this is obviously a crucial property. Furthermore, the meaning of complex expressions is a function of the meaning of the parts, and, crucially, how the parts are put together. Take a complex word such as birdsong, a compound made up of the words bird and song. It denotes a kind of song, produced by birds: the complex meaning is a function of the meaning of the component parts. But if the two parts are put together in the reverse order, the meaning changes: a songbird denotes not a kind of song, but a kind of bird, namely one which belongs to a species capable of singing. This is completely predictable from the rules of the language, in this case English.

Similarly the meaning of (10a) is a function of the meaning of the words it is made up of, and how the words are put together, as shown by the contrast between (10a) and (10b), where the meaning is different (in predictable ways).

(10)  a. The leopard ate the girl.
      b. The girl ate the leopard.

What about the chickadee calls? What do they mean? Do the individual notes have meaning, and is the meaning of the call then a function of the meaning of the individual notes and how they are put together? In general, bird calls, and birdsong, are used to communicate things such as identity of the caller (species identity, flock identity or individual identity), desire to mate, or ownership of a territory, or fitness (Doupe and Kuhl 1999). These messages are not a function of the meaning of the component parts of the call/song, but of ‘global’ properties of the call/song, such as the choice of type of call (one call type may signal desire to mate, another call type species identity), or the intensity or duration of the song (a long stretch of song signals a higher degree of fitness than a short one), and so on.

As for the chickadees it has been observed, for the Carolina chickadee, a very close relative of the black-capped chickadee, that different note types tend to occur “in conjunction with different locomotory acts such as flight, landing, twisting on the perch, and so on” (Hailman & al.: 64). The call may thus serve to communicate to other birds the position or direction, or other “locomotory tendencies” of the caller. Hailman & al. (1987) suggest that “the ratios of repetitions of these notes types /…/ might thus encode the absolute and relative strengths of competing tendencies”. For

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5 The computational properties of types of grammars will be discussed in Lecture 9.
example, repeating the C-note more times than the B-note would signal that the caller is more inclined to take off than to stay perched.

Hailman & al. (1987) also note that the D-note seems to have a special ‘meaning’ or function. It occurs almost as frequently as all the other notes put together; most calls end in a series of D-notes. They suggest, following Mammen and Nowicki (1981) and Nowicki (1983), that the D-note has a group-identity function: “Birds of a given flock tend to show high similarity in subtle acoustic properties, especially in the D-note /…/ and when birds are caged together their D-notes change to become more similar with one another /…/” (Hailman & al. 1987).

Even granted that the chickadee note types are associated with a meaning, and that the meaning of the whole call (the locomotory inclination of the caller) is, in a sense, a function of how the note-types are put together, including how many times they are repeated, there is an important difference between the meanings of the note types when compared with the meaning associated with morphemes in human language: A morpheme (or word) is a piece of linguistic form, a sequence of speech sounds/phonemes, linked to a unique meaning, which typically can be characterized as a concept, where furthermore the link between the form and the meaning is arbitrary and conventional. For instance in English the spoken form [ðə] is linked to the concept ‘definite’, the form [ðə] is linked to the concept ‘tree’, and so on. Concepts, in this view, are the minimal units of thought.

Even if the chickadee note types are associated with a meaning, where the association, furthermore, is arbitrary (so that, in that sense, they qualify as Saussurean signs, see Lecture 2), the meaning is not a concept, but rather an emotional state of the caller, for instance ‘I’m inclined to stay perched’, where the number of repetition of the note type signals how strong the inclination is.

Intermediate conclusions

In today's ethology ('animal psychology') it is widely accepted that at least some animals use 'words' in the sense of units of form (say, alarm calls) which refer to an external object. For example vervet monkeys have a set of different alarm calls for different predators (one call for leopard, another call for eagle, a third call for snake); see Seyfarth, Cheney, and Marler 1980; Hauser 1996: 618ff. Assuming that the predator is represented in the mind of the monkey as a concept, the vervet monkeys then arguably have a small set of words in the sense of units of form linked to unique concepts, where the link is arbitrary (although it is probably innate rather than being established by convention and learned by each new generation). What we do know for certain is that at least chimpanzees and bonobos, with appropriate training, are capable of acquiring a fairly extensive set of words/morphemes, in the sense of ‘form-concept pairs’. It does not seem to be the case, however, that monkeys or apes in the wild would have a system of communication governed by syntactic rules. Furthermore, the Nim project indicated that chimpanzees are incapable, even with extensive training, of acquiring a grammar which is more complex than elementary linearization rules combining at most two items. The grammar he employed was a finite state grammar but restricted to combining two categories.

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6 As reported in Hauser (1996: 632), a study by Nowicki and Nelson (1990) suggests that the note-types of chickadees may in fact not be discrete, but that there is gradation between them. If this is right, then the system may not even be combinatorial.

7 This conclusion is contested, though, by some scholars, particularly E.S. Savage-Rumbaugh; see seminar questions.
The chickadee calls have a syntax which, although it is formally simple, is capable of generating in principle an infinite number of different calls. The calls do not display hierarchic structure, though. Furthermore, the chickadees appear not to have any words/morphemes in the restricted sense of ‘form-concept pairs’.

**Displaced reference: bee dance**

Human languages famously have the property called *displaced reference*, meaning that we are capable of talking about objects and events which are not present in the immediate environment. Most, in fact nearly all, animal communication seems to lack this property. As mentioned earlier, even Nim’s utterances were all about wanting something. Thus, even if the object of his desire was not immediately present, the utterance would be about himself, his own state of mind.

There is one animal which is known for being capable of displaced reference, though, namely honeybees. A forager honeybee which has found a food source is able to communicate to other bees in the hive the location of this food source by the so called ‘waggle dance’, as first described by Karl von Frisch (see von Frisch 1967).

In the waggle dance, the dancer moves in a straight line (the wagging run) and circles back, alternating between a left and a right return path so that the entire dance path takes on a figure-eight shape /…/. On a vertical comb, the direction of the wagging run relative to gravity indicates the direction to the food relative to the sun’s azimuth in the field. The velocity of the dance (and the number of figure eight units per unit of time) depends on the distance to the food source. A few follower bees keep close contact with the dancer, and these bees may be recruited to visit the food. (Michelsen 1999)

Obviously this is an extremely limited use of displaced reference. Yet it shows that the capacity for displaced reference does not require intelligence of the human order, but can evolve in animals with otherwise limited cognitive capacities.

**Discussion**

In comparative studies of animal communication and human language it is common to start with a list of properties claimed to be criterial of human language, and then proceed to discuss whether these properties are in fact unique to human language. The most famous list is Charles Hockett’s (1960) 13 design features of language.
As you can verify for yourself, the chickadee calls (if Hailman & al. are right) observe most of these properties. They clearly do not observe 10 (Displacement) or 13 (Duality of patterning). To what extent they observe 12 (Traditional transmission) is a moot point; some animals fail to develop the calls of their species when raised in isolation. We have just seen that displacement occurs in at least one non-human communication system. What about Duality of Patterning? This feature may indeed be unique to human language. In human language a meaningful unit such as tree, the, or -ness is itself composed of meaningless units, the phonemes, according to rules of grammar (phonology). The minimal meaningful units in the chickadee calls were the note-types. But these are not, as far as we know, composed out of smaller meaning less units. Likewise, the vervets' predator warning calls, claimed to represent a semantically more sophisticated form of signs than for example the chickadee calls, have not been observed to be composed out of smaller, meaningless units.
Human sign language, such as ASL or BSL (British Sign Language), observes duality of patterning. The manual signs are made up of components which are themselves not meaningful, including handshape, position of the hand, and movement of the hand. In addition a facial expression (such as raising or lowering the eyebrows) may contribute to a sign. It is not clear from Terrace (1983, 1987) whether Nim’s pidgin ASL signs exhibited such complex composition, thus observing duality of patterning.

Our brief discussion of chickadees and the language learnt by Nim suggests that hierarchic structure may be a feature which is unique to human language. Judging by Hauser 1996, a fairly recent and very detailed discussion of animal communication research, no clear cases of hierarchic syntactic structure in animal communication have been discovered so far.

References used


**Recommended reading:**

Both works by Terrace in the list above are highly readable. The university library do not have them, unfortunately. Hailman & al.’s papers can be found in the library. The volumes are restricted to a one day loan. Hailman & Ficken 1986 is shorter and more focused on the questions taken up in the lecture.

http://en.wikipedia.org/wiki/Animal_language
http://en.wikipedia.org/wiki/Animal_communication
These pages contain a wealth of encyclopaedic facts about animal communication.

http://www.ecs.soton.ac.uk/~harnad/Papers/Py104/pinker.langacq.html
(especially sections 1-3)

http://www.wjh.harvard.edu/~mnkylab/
This website has lots of articles, for downloading, about animal communication, especially primates. Most of them are highly technical and specialized. I recommend the three following ones:


Hauser, M.D. & Fitch, W.T. 2003. ‘What are the uniquely human components of the language faculty?’