Introduction

"Language is the way we interact and communicate, so, naturally, the means of communication and the conceptual background that's behind it, which is more important, are used to try to shape attitudes and opinions and induce conformity and subordination. Not surprisingly, it was created in the more democratic societies." - Chomsky

Language is a central part of everyday life and communication a natural human necessity. For those reasons there has been a high interest in their properties. However describing the processes of language turns out to be quite hard.

We can define language as a system of communication through which we code and express our feelings, thoughts, ideas and experiences.[1]

Already Plato was concerned with the nature of language in his dialogue "Cratylus", where he discussed first ideas about nowadays important principles of linguistics namely morphology and phonology. Gradually philosophers, natural scientists and psychologists became interested in features of language.

Since the emergence of the cognitive science in the 50's and Chomsky's criticism on the behaviourist view, language is seen as a cognitive ability of humans, thus incorporating linguistics in other major fields like computer science and psychology. Today, psycho-linguistics is a discipline on its own and its most important topics are acquisition, production and comprehension of language.

Especially in the 20th century many studies concerning communication have been conducted, evoking new views on old facts. New techniques, like CT, MRI and fMRI or EEG, as described in Methods of Behavioural and Neuroscience Methods, made it possible to observe brain during communication processes in detail.

Later on an overview of the most popular experiments and observed effects is presented. But in order to understand those one needs to have a basic idea of semantics and syntax as well as of linguistic principles for processing words, sentences and full texts.
Finally some questions will arise: How is language affected by culture? Or in philosophical terms, the discussion about the relationship between language and thoughts has to be developed. [edit] Language as a cognitive ability
[edit] Historical review on Psycholinguistics & Neurolinguistics

Starting with philosophical approaches, the nature of the human language had ever been a topic of interest. Galileo in the 16th century saw the human language as the most important invention of humans. Later on in the 18th century the scientific study of language began by psychologists. Wilhelm Wundt (founder of the first laboratory of psychology) saw language as the mechanism by which thoughts are transformed into sentences. The observations of Wernike and Broca (see chapter 9) were milestones in the studies of language as a cognitive ability. In the early 1900s the behaviouristic view influenced the study of language very much. In 1957 B.F.Skinner published his book "Verbal Behaviour", in which he proposed that learning of language can be seen as a mechanism of reinforcement. Noam Chomsky (quoted at the beginning of this chapter) published in the same year "Syntactic Structures". He proposed that the ability to invent language is somehow coded in the genes. That led him to the idea that the underlying basis of language is similar across cultures. There might be some kind of universal grammar as a base, independent of what kind of language (including sign language) might be used by humans. Further on Chomsky published a review of Skinner’s "Verbal Behaviour" in which he presented arguments against the behaviouristic view. There are still some scientists who are convinced that it does not need a mentalist approach like Chomsky proposed, but in the meantime most agree that human language has to be seen as a cognitive ability. [edit] Current goals of Psycholinguistics

A natural language can be analysed at a number of different levels. In linguistics we differ between phonology (sounds), morphology (words), syntax (sentence structure), semantics (meaning), and pragmatics (use). Linguists try to find systematic descriptions capturing the regularities inherent in the language itself. But a description of natural language just as a abstract structured system, can not be enough. Psycholinguists rather ask, how the knowledge of language is represented in the brain, and how it is used. Today's most important research topics are:

1) comprehension: How humans understand spoken as well as written language, how language is processed and what interactions with memory are involved.

2) speech production: Both the physical aspect of speech production, and the mental process that stands behind the uttering of a sentence.

3) acquisition: How people learn to speak and understand a language. [edit] Characteristic features

What is a language? What kinds of languages do exist? Are there characteristic features that are unique in human language?

There are plenty of approaches how to describe languages. Especially in computational linguistics researchers try to find formal definitions for different kinds of languages. But for psychology other aspects of language than its function as pure system of communication are of central interest. Language is also a tool we use for social interactions starting with the exchange of news up to the identification of social groups by their dialect. We use it for expressing our feelings, thoughts, ideas etc.

Although there are plenty ways to communicate (consider Non-Human-Language) humans expect their system of communication - the human language to be unique. But what is it that makes the human language so special and unique?

Four major criteria have been proposed by Professor Franz Schmalhofer from the University of Osnabrück as explained below:

-semanticity
-displacement
-creativity
-structure dependency
Semanticity means the usage of symbols. Symbols can either refer to objects or to relations between objects. In the human language words are the basic form of symbols. For example the word "book" refers to an object made of paper on which something might be written. A relation symbol is the verb "to like" which refers to the sympathy of somebody to something or someone.

The criterion of displacement means that not only objects or relations at presence can be described but there are also symbols which refer to objects in another time or place. The word "yesterday" refers to day before and objects mentioned in a sentence with "yesterday" refer to objects from another time than the present one. Displacement is about the communication of events which had happened or will happen and the objects belonging to that event.

Having a range of symbols to communicate these symbols can be newly combined. Creativity is the probable most important feature. Our communication is not restricted to a fixed set of topics or predetermined messages. The combination of a finite set of symbols to an infinite number of sentences and meaning. With the infinite number of sentences the creation of novel messages is possible. How creative the human language is can be illustrated by some simple examples like the process that creates verbs from nouns. New words can be created, which do not exist so far, but we are able to understand them.

Examples:

- leave the boat on the beach -> beach the boat
- keep the aeroplane on the ground -> ground the aeroplane
- write somebody an e-mail -> e-mail somebody

Creative systems are also found in other aspects of language, like the way sounds are combined to form new words. i.e. prab, orgu, zabi could be imagined as names for new products.

To avoid an arbitrary combination of symbols without any regular arrangement "true" languages need structure dependency. Combining symbols the syntax is relevant. A change in the symbol order might have an impact on the meaning of the sentence. For example “The dog bites the cat” has obviously a different meaning than “The cat bites the dog” based on the different word arrangement of the two sentences.

Non-Human Language - Animal Communication

Forms of Communication

As mentioned before human language is just one of quite a number of communication forms. Different forms of communication can be found in the world of animals. From a little moth to a giant whale, all animals appear to have the use of communication.

Not only humans use facial expression for stressing utterances or feeling, facial expressions can be found among apes. The expression, for example "smiling" indicates cooperativeness and friendliness in both the human and the ape world. On the other hand an ape showing teeth indicates the willingness to fight.

Posture is a very common communicative tool among animals. Lowering the front part of the body and extending the front legs is a sign of dogs that they are playful whereas lowering the full body is a dog's postural way to show its submissiveness. Postural communication is known in both human and non-human primates.

Besides facial expression, gesture and posture that are found in human communication, there are other communicative devices which are either just noticeable by the sub-consciousness of humans like scent or cannot be found amongst humans like light, colour and electricity. The chemicals which are used for a communicative function are called pheremones. Those pheremones are used to mark territorial or to signal its reproductive readiness. For animals scent is a very important tool which predominates their mating behaviour. Humans are influenced in their mating behaviour by scent as well but there are more factors to that behaviour so that scent is not predominating.

The insects use species-dependent light patterns to signal identity, sex and location. For example the octopus changes colour for signalling territorial defence and mating readiness. In the world of birds colour is wide spread, too. The male peacock has colourful feathering to impress female peahens as a part of mating behaviour. These ways of communication help to live in a community and survive in certain environment.
As mentioned above it is possible to describe the uniqueness of human language by four criteria (semanticity, displacement, creativity and structural dependency) which are important devices in the human language to form a clear communication between humans. To see if these criteria exist in animal communication - i.e. if animals possess a "true" language - several experiments with non-human primates were performed. Non-human primates were taught American Sign Language (ASL) and a specially developed token language to detect in how far they are capable of linguistic behaviour. Can semanticity, displacement, creativity and structure dependency be found in non-human language?

Experiments

1. Human language In 1948, in Orange Park, Florida, Keith and Cathy Hayes tried to teach English words to a chimpanzee named Viki. She was raised as if she were a human child. The chimpanzee was taught to "speak" easy English words like "cup". The experiment failed since with the supralaryngal anatomy and the vocal fold structure that chimpanzees have it is impossible for them to produce human speech sounds. The failure of the Viki experiment made scientists wonder how far are non-human primates able to communicate linguistically.

2. Sign language From 1965 to 1972 the first important evidence showing rudiments of linguistic behaviour was "Washoe", a young female chimpanzee. The experimenters Allen and Beatrice Gardner conducted an experiment where Washoe learned 130 signs of the American Sign Language within three years. Showing pictures of a duck to Washoe and asking WHAT THAT? she combined the symbols of WATER and BIRD to create WATER BIRD as she had not learned the word DUCK (the words in capital letters refer to the signs the apes use to communicate with the experimenter).

It was claimed that Washoe was able to arbitrarily combine signs spontaneously and creatively. Some scientists criticised the ASL experiment of Washoe because they claimed that ASL is a loose communicative system and strict syntactic rules are not required. Because of this criticism different experiments were developed and performed which focus on syntactic rules and structure dependency as well as on creative symbol combination.

A non-human primate named "Kanzi" was trained by Savage-Rumbaugh in 1990. Kanzi was able to deal with 256 geometric symbols and understood complex instructions like GET THE ORANGE THAT IS IN THE COLONY ROOM. The experimenter worked with rewards.

A question which arose was whether these non-human primates were able to deal with human-like linguistic capacities or if they were just trained to perform a certain action to get the reward.

For more detailed explanations of the experiments see The Mind of an Ape.

Can the characteristic language features be found in non-human communication?

Creativity seems to be present in animal communication as amongst others Washoe showed with the creation of WATER BIRD for DUCK. Although some critics claimed that creativity is often accidental or like in the case of Washoe's WATER BIRD the creation relays on the fact that water and bird were present. Just because of this presence Washoe invented the word WATER BIRD.

In the case of Kanzi a certain form of syntactic rules was observed. In 90% of Kanzi's sentences there was first the invitation to play and then the type of game which Kanzi wanted to play like CHASE HIDE, TICKLE SLAP and GRAB SLAP. The problem which was observed was that it is not always easy to recognise the order of signs. Often facial expression and hand signs are performed at the same time. One ape signed the sentence I LIKE COKE by hugging itself for "like" and forming the sign for "coke" with its hands at the same time. Noticing an order in this sign sentence was not possible.

A certain structural dependency could be observed at Kanzi's active and passive sentences. When Matata, a fellow chimpanzee was grabbed Kanzi signed GRAB MATATA and when Matata was performing an action such as biting Kanzi produced MATATA BITE. It has not yet been proved that symbolic behaviour is occurring. Although there are plenty evidences that creativity and displacement occur in animal communication some critics claim that these evidences can be led back to dressage and training. It was claimed that linguistic behaviour cannot be proved as it is
more likely to be a training to correctly use linguistic devices. Apes show just to a little degree syntactic behaviour and they are not able to produce sentences containing embedded structures. Some linguists claim that because of such a lack of linguistic features non-human communication cannot be a "true" language. Although we do not know the capacity of an ape's mind it does not seem that the range of meanings observed in ape's wild life approach the capaciousness of semanticity of human communication. Furthermore apes seem not to care to much about displacement as it appears that they do not communicate about imaginary pasts or futures. All in all non-human primeate communication consisting of graded series of communication shows little arbitrariness. The results with non-human primates led to a controversial discussion about linguistic behaviour. Many researchers claimed that the results were influenced by dressage. For humans language is a communication form suited to the patterns of human life. Other communication systems are better suited for fellow creatures and their mode of existence. Now that we know that there is a difference between animal communication and human language we will see detailed features of the human language. [edit] Language Comprehension & Production [edit] Language features – Syntax and Semantics

In this chapter the main question will be "how do we understand sentences?". To find an answer to that problem it is necessary to have a closer look at the structure of languages. The most important properties every human language provides are rules which determine the permissible sentences and a hierarchical structure (phonemes as basic sounds, which constitute words, which in turn constitute phrases, which constitute sentences, which constitute texts). These feature of a language enable humans to create new unique sentences. The fact that all human languages have a common ground even if they developed completely independent from one another may lead to the conclusion that the ability to process language must be innate. Another evidence of a inborn universal grammar is that there were observations of deaf children who were not taught a language and developed there own form of communication which provided the same basic constituents. Two basic abilities human beings have to communicate is to interpret the syntax of a sentence and the knowledge of the meaning of single words, which in combination enables them to understand the semantic of whole sentences. Many experiments have been done to find out how the syntactical and semantical interpretation is done by human beings and how syntax and semantics works together to construct the right meaning of a sentence. Physiological experiments had been done in which for example the event-related potential (ERP) in the brain was measured as well as behavioristic experiments in which mental chronometry, the measurement of the time-course of cognitive processes, was used. Physiological experiments showed that the syntactical and the semantical interpretation of a sentence takes place separately from each other. These results will be presented below in more detail.

Physiological Approach

Semantics File:Cpnp2.jpg Semantical incorrectness in a sentence evokes a N400 in the ERP

Semantical incorrectness in a sentence evokes an N400 in the ERP The exploration of the semantic sentence processing can be done by the measurement of the event-related potential (ERP) when hearing a semantical correct sentence in comparison to a semantical incorrect sentence. For example in one experiment three reactions to sentences were compared:

Semantically correct: “The pizza was too hot to eat.” Semantically wrong: “The pizza was too hot to drink.” Semantically wrong: "The pizza was too hot to cry."

In such experiments the ERP evoked by the correct sentence is considered to show the ordinary sentence processing. The variations in the ERP in case of the incorrect sentences in contrast to the ERP of the correct sentence show at what time the mistake is recognized. In case of semantic incorrectness there was observed a strong negative signal about 400ms after perceiving the critical word which did not occure, if the sentence was semantically correct. These effects were observed mainly in the parital and central area. There was also found evidence that the N400 is the stronger the less the word fits semantically. The word “drink” which fits a little bit more in the context caused a
weaker N400 than the word "cry". That means the intensity of the N400 correlates with the degree of the semantic mistake. The more difficult it is to search for a semantic interpretation of a sentence the higher is the N400 response.

Syntax File:Cpnp4.jpg Syntactical incorrectness in a sentence can evoke an ELAN (early left anterior negativity) in the electrodes above the left frontal lobe after 120ms.

To examine the syntactical aspects of the sentence processing a quite similar experiment as in the case of the semantic processing was done. There were used syntactical correct sentences and incorrect sentences, such as (correct:) "The cats won't eat..." and (incorrect:) "The cats won't eating...". When hearing or reading a syntactical incorrect sentence in contrast to a syntactical correct sentence the ERP changes significantly on two different points of time. First of all there a very early increased response to syntactical incorrectness after 120ms. This signal is called the 'early left anterior negativity' because it occurs mainly in the left frontal lobe. This advises that the syntactical processing is located amongst others in Broca's area which is located in the left frontal lobe. The early response to syntactical mistakes also indicates that the syntactical mistakes are detected earlier than semantic mistakes.

The other change in the ERP when perceiving a syntactical wrong sentence occurs after 600ms in the parital lobe. The signal is increasing positively and is therefore called P600. Possibly the late positive signal is reflecting the attempt to reconstruct the grammatical problematic sentence to find a possible interpretation. File:Cpnp3001.jpg Syntactical incorrectness in a sentence evokes after 600ms a P600 in the electrodes above the parital lobe.

To summarize the three important ERP-components: First of all there occurs the ELAN at the left frontal lobe which shows a violation of syntactical rules. After it follows the N400 in central and parital areas as a reaction to a semantical incorrectness and finally there occurs a P600 in the parital area which probably means a reanalysis of the wrong sentence.

Behavioristic Approach – Parsing a Sentence

Behavioristic experiments about how human beings parse a sentence often use syntactically ambiguous sentences. Because it is easier to realize that sentence-analysing mechanisms called parsing take place when using sentences in which we cannot automatically constitute the meaning of the sentence. There are two different theories about how humans parse sentences. The syntax-first approach claims that syntax plays the main part whereas semantics has only a supporting role, whereas the interactionist approach states that both syntax and semantics work together to determine the meaning of a sentence. Both theories will be explained below in more detail.

The Syntax-First Approach of Parsing The syntax-first approach concentrates on the role of syntax when parsing a sentence. That humans infer the meaning of a sentence with help of its syntactical structure (Kako and Wagner 2001) can easily be seen when considering Lewis Carroll’s poem 'Jabberwocky':

"Twas brillig, and the slithy toves Did gyre and gimble in the wabe: All mimsy were the borogoves, And the mome raths outgrabe."

Although most of the words in the poems have no meaning one may ascribe at least some sense to the poem because of its syntactical structure.

There are many different syntactic rules that are used when parsing a sentence. One important rule is the principle of late closure which means that a person assumes that a new word he perceives is part of the current phrase. That this principle is used for parsing sentences can be seen very good with help of a so called garden-path sentence. Experiments with garden-path sentences have been done by Frazier and Fayner 1982. One example of a garden-path sentence is: "Because he always jogs a mile seems a short distance to him." When reading this sentence one first wants to continue the phrase "Because he always jogs" by adding "a mile" to the phrase, but when reading further one realizes that the words "a mile" are the beginning of a new phrase. This shows that we parse a sentence by trying to add new words to a phrase as long as possible. Garden-path sentences show that we use the principle of late closure as long it makes syntactically sense to add a word to the current phrase but when the sentence starts to get incorrect semantics are often used to rearrange the sentence. The syntax-first approach does not disregard semantics.
According to this approach we use syntax first to parse a sentence and semantics is later on used to make sense of the sentence.

Apart from experiments which show how syntax is used for parsing sentences there were also experiments on how semantics can influence the sentence processing. One important experiment about that issue has been done by Daniel Slobin in 1966. He showed that passive sentences are understood faster if the semantics of the words allow only one subject to be the actor. Sentences like “The horse was kicked by the cow.” and “The fence was kicked by the cow.” are grammatically equal and in both cases only one syntactical parsing is possible. Nevertheless the first sentence semantically provides two subjects as possible actors and therefore it needs longer to parse this sentence. By measuring this significant difference Daniel Slobin showed that semantics play an important role in parsing a sentence, too.

**The Interactionist Approach of Parsing**

The interactionist approach ascribes a more central role to semantics in parsing a sentence. In contrast to the syntax-first approach, the interactionist theory claims that syntax is not used first but that semantics and syntax are used simultaneously to parse the sentence and that they work together in clarifying the meaning. There have been made several experiments which provide evidence that semantics are taking into account from the very beginning reading a sentence. Most of these experiments are working with the eye-tracking techniques and compare the time needed to read syntactical equal sentences in which critical words cause or prohibit ambiguity by semantics. One of these experiments has been done by John Trueswell and coworkers in 1994. He measured the eye movement of persons when reading the following two sentences:

The defendant examined by the lawyer turned out to be unreliable. The evidence examined by the lawyer turned out to be unreliable.

He observed that the time needed to read the words "by the lawyer" took longer in case of the first sentence because in the first sentence the semantics first allow an interpretation in which the defendant is the one who examines, while the evidence only can be examined. This experiment shows that the semantics also play a role while reading the sentence which supports the interactionist approach and argues against the theory that semantics are only used after a sentence has been parsed syntactically.

**Coherence**

Coherence is the semantic relation of information in different parts of a text to each other. In most cases coherence is achieved by inference; that means that a reader draws information out of a text that is not explicitly stated in this text. For further information the chapter [Neuroscience of Text Comprehension] should be considered.

**Situation Model**

A situation model is a mental representation of what a text is about. This approach proposes that the mental representation people form as they read a story does not indicate information about phrases, sentences, paragraphs, but a representation in terms of the people, objects, locations, events described in the story (Goldstein 2005, p. 374).

For a more detailed description of situation models, see [Situation Models]

**Using Language**

Conversations are dynamic interactions between two or more people (Garrod & Pickering, 2004 as cited in Goldstein 2005). The important thing to mention is that conversation is more than the act of speaking. Each person brings in his or her knowledge and conversations are much easier to process if participants bring in shared knowledge. In this way, participants are responsible of how they bring in new knowledge. H.P. Grice proposed in 1975 a basic principle of conversation and four "conversational maxims." His cooperative principle states that "the speaker and listener agree that the person speaking should strive to make statements that further the agreed goals of conversation." The four maxims state the way of how to achieve this principle.

1. Quantity: The speaker should try to be informative, no over-/underinformation.
2. Quality: Do not say things which you believe to be false or lack evidence of.
3. Manner: Avoiding being obscure or ambiguous.
4. Relevance: Stay on topic of the exchange.

An example of a rule of conversation incorporating three of those maxims is the given-new-contract. It states that the speaker should construct sentences so that they include given and new information. (Haviland & Clark, 1974 as cited in Goldstein, 2005). Consequences of not following this rule were demonstrated by Susan Haviland and Herbert Clark by presenting pairs of sentences (either following or ignoring the given-new-contract) and measuring the time participants needed until they fully understood the sentence. They found that participants needed longer in pairs of the type:

<table>
<thead>
<tr>
<th>We checked the picnic supplies.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The beer was warm.</td>
</tr>
<tr>
<td>Rather than:</td>
</tr>
<tr>
<td>We got some beer out of the trunk.</td>
</tr>
<tr>
<td>The beer was warm.</td>
</tr>
</tbody>
</table>

The reason that it took longer to comprehend the second sentence of the first pair is that inferencing has to be done (beer has not been mentioned as being part of the picnic supplies). (Goldstein, 2005, p.377-378)

Language, Culture and Cognition

In the parts above we saw that there has been a lot of research of language, from letters through words and sentences to whole conversations. Most of the research described in the parts above was processed by English speaking researchers and the participants were English speaking as well. Can those results be generalised for all languages and cultures or might there be a difference between English speaking cultures and for example cultures with Asian or African origin?

Imagine our young man from the beginning again: Knut! Now he has to prepare a presentation with his friend Chang for the next psychology seminar. Knut arrives at his friend's flat and enters his living-room, glad that he made it there just in time. They have been working a few minutes when Chang says: "It has become cold in here!" Knut remembers that he did not close the door, stands up and...

"stop! What is happening here?!"

This part is concerned with culture and its connection to language. Culture, not necessarily in the sense of "high culture" like music, literature and arts but culture is the "know-how" a person must have to tackle his or her daily life. This know-how might include high culture but it is not necessary.

Culture and Language

Scientists wondered in how far culture affects the way people use language. In 1991 Yum studied the indirectness of statements in Asian and American conversations. The statement "Please shut the door" was formulated by Americans in an indirect way. They might say something like "The door is open" to signal that they want to door to be shut. Even more indirect are Asian people. They often do not even mention the door but they might say something like "It is somewhat cold today". Another cultural difference affecting the use of language was observed by Nisbett in 2003 in observation about the way people pose questions. When American speaker ask someone if more tea is wanted they ask something like "More tea?". Different to this Asian people would ask if the other one would like more drinking as for Asians it seems obvious that tea is involved and therefore mentioning the tea would be redundant. For Americans it is the other way round. For them it seems obvious that drinking is involved so they just mention the tea. This experiment and similar ones indicate that people belonging to Asian cultures are often relation orientated. Asians focus on relationships in groups. Contrasting, the Americans concentrate on objects. The involved object and its features are more important than the object's relation to other objects. These two different ways of focusing shows that language is affected by culture.

A experiment which clearly shows these results is the mother-child interaction which was observed by Fernald and Morikawa in 1993. They studied mother-child talk of Asian and American mothers. An American mother trying to show and explain a car to her child often repeated the object "car" and wants the child to repeat it as well. The
mother focuses on the features of the car and labels the importance of the object itself. The Asian mother shows the toy car to her child, gives the car to the child and wants it to give the car back. The mother shortly mentions that the object is a car but concentrates on the importance of the relation and the politeness of giving back the object.

Realising that there are plenty differences in how people of different cultures use language the question arises if languages affects the way people think and perceive the world. What is the connection between language and cognition?

Sapir-Whorf Hypothesis

In the 1950's Edward Sapir and Benjamin Whorf proposed the hypothesis that the language of a culture affects the way people think and perceive. The controversial theory was question by Elenor Rosch who studied colour perception of Americans and Danis who are members of an stone-age agricultural culture in the Iran. Americans have several different categories for colour as for example blue, red, yellow and so on. Danis just have two main colour categories. The participants were ask to recall colours which were shown to them before. That experiment did not show significant differences in colour perception and memory as the Sapir-Whorf hypothesis presumes.

File:Color-naming exp.jpg Color-naming experiment by Roberson et al. (2000)

Categorical Perception

Nevertheless a support for the Sapir-Whorf hypothesis was Debi Roberson's demonstration for categorical perception based on the colour perception experiment by Rosch. The participants, a group of English-speaking British and another group of Berinmos from New Guinea were ask to name colours of a board with colour chips. The Berinmos distinguish between five different colour categories and the denotation of the colour names is not equivalent to the British colour denotation. Apart from these differences there are huge differences in the organisation of the colour categories. The colours named green and blue by British participants where categorised as nol which also covers colours like light-green, yellow-green, and dark blue. Other colour categories differ similarly.

The result of Roberson's experiment was that it is easier for British people to discriminate between green and blue whereas Berinmos have less difficulties distinguishing between Nol and Wap. The reaction to colour is affected by language, by the vocabulary we have for denoting colours. It is difficult for people to distinguish colours from the same colour category but people have less trouble differentiating between colours from different categories. Both groups have categorical colour perception but the results for naming colours depends on how the colour categories were named. All in all it was shown that categorical perception is influenced by the language use of different cultures.

These experiments about perception and its relation to cultural language usage leads to the question whether thought is related to language with is cultural differences. Is thought dependent on, or even caused by language?

Historical theories

An early approach was proposed by J.B. Watson's in 1913. His peripheralist approach was that thought is a tiny not noticeable speech movement. While thinking a person performs speech movements as he or she would do while talking. A couple year later, in 1921 Wittgenstein poses the theory that the limits of a person's language mean the limits of that person's world. As soon as a person is not able to express a certain content because of a lack of vocabulary that person is not able to think about those contents as they are outside of his or her world. Wittgenstein's theory was doubted by some experiments with babies and deaf people.

Present research

To find some evidence for the theory that language and culture is affecting cognition Lian-hwang Chiu designed an experiment with American and Asian children. The children were asked to group objects in pairs so that these objects fit together. On picture that was shown to the children there was a cow, a chicken and some grass. The children had to decided which of the two objects fitted together. The American children mostly grouped cow and chicken because of group of animals they belong to. Asian children more often combined the cow with the grass as there is the relation of the cow normally eating grass.
In 2000 Chui repeated the experiment with words instead of pictures. A similar result was observed. The American children sorted their pairs taxonomically. Given the words "panda", "monkey" and "banana" American children paired "panda" and "monkey". Chinese children grouped relationally. They put "monkey" with "banana". Another variation of this experiment was done with bilingual children. When the task was given in English to the children they grouped the objects taxonomically. A Chinese task caused a relational grouping. The language of the task clearly influenced on how to group the objects. That means language may affects the way people think.

The results of plenty experiments regarding the relation between language, culture and cognition let assume that culture affects language and cognition is affected by language. Our way of thinking is influenced by the way we talk and thought can occur without language but the exact relation between language and thought remains to be determined.

**Introduction**

"Language is the way we interact and communicate, so, naturally, the means of communication and the conceptual background that's behind it, which is more important, are used to try to shape attitudes and opinions and induce conformity and subordination. Not surprisingly, it was created in the more democratic societies." - Chomsky

Language is a central part of everyday life and communication a natural human necessity. For those reasons there has been a high interest in their properties. However describing the processes of language turns out to be quite hard.

We can define language as a system of communication through which we code and express our feelings, thoughts, ideas and experiences. [1]

Already Plato was concerned with the nature of language in his dialogue "Cratylus", where he discussed first ideas about nowadays important principles of linguistics namely morphology and phonology. Gradually philosophers, natural scientists and psychologists became interested in features of language.

Since the emergence of the cognitive science in the 50's and Chomsky’s criticism on the behaviourist view, language is seen as a cognitive ability of humans, thus incorporating linguistics in other major fields like computer science and psychology. Today, psycho-linguistics is a discipline on its own and its most important topics are acquisition, production and comprehension of language.

Especially in the 20th century many studies concerning communication have been conducted, evoking new views on old facts. New techniques, like CT, MRI and fMRI or EEG, as described in *Methods of Behavioural and Neuroscience Methods* [2], made it possible to observe brain during communication processes in detail.

Later on an overview of the most popular experiments and observed effects is presented. But in order to understand those one needs to have a basic idea of semantics and syntax as well as of linguistic principles for processing words, sentences and full texts.

Finally some questions will arise: How is language affected by culture? Or in philosophical terms, the discussion about the relationship between language and thoughts has to be developed.

**Language as a cognitive ability**

**Historical review on Psycholinguistics & Neurolinguistics**

Starting with philosophical approaches, the nature of the human language had ever been a topic of interest. Galileio in the 16th century saw the human language as the most important invention of humans. Later on in the 18th century the scientific study of language began by psychologists. Wilhelm Wundt (founder of the first laboratory of psychology) saw language as the mechanism by which thoughts are transformed into sentences. The observations of Wernike and Broca (see chapter 9) were milestones in the studies of language as a cognitive ability. In the early 1900s the behaviouristic view influenced the study of language very much. In 1957 B.F.Skinner published his book "Verbal Behaviour", in which he proposed that learning of language can be seen as a mechanism of reinforcement.
Noam Chomsky (quoted at the beginning of this chapter) published in the same year "Syntactic Structures". He proposed that the ability to invent language is somehow coded in the genes. That led him to the idea that the underlying basis of language is similar across cultures. There might be some kind of universal grammar as a base, independent of what kind of language (including sign language) might be used by humans. Further on Chomsky published a review of Skinner’s "Verbal Behaviour" in which he presented arguments against the behaviouristic view. There are still some scientists who are convinced that it does not need a mentalist approach like Chomsky proposed, but in the meantime most agree that human language has to be seen as a cognitive ability.

**Current goals of Psycholinguistics**

A natural language can be analysed at a number of different levels. In linguistics we differ between phonology (sounds), morphology (words), syntax (sentence structure), semantics (meaning), and pragmatics (use). Linguists try to find systematic descriptions capturing the regularities inherent in the language itself. But a description of natural language just as a abstract structured system, can not be enough. Psycholinguists rather ask, how the knowledge of language is represented in the brain, and how it is used. Today's most important research topics are:

1) comprehension: How humans understand spoken as well as written language, how language is processed and what interactions with memory are involved.
2) speech production: Both the physical aspect of speech production, and the mental process that stands behind the uttering of a sentence.
3) acquisition: How people learn to speak and understand a language.

**Characteristic features**

What is a language? What kinds of languages do exist? Are there characteristic features that are unique in human language?

There are plenty of approaches how to describe languages. Especially in computational linguistics researchers try to find formal definitions for different kinds of languages. But for psychology other aspects of language than its function as pure system of communication are of central interest. Language is also a tool we use for social interactions starting with the exchange of news up to the identification of social groups by their dialect. We use it for expressing our feelings, thoughts, ideas etc.

Although there are plenty ways to communicate (consider Non-Human-Language) humans expect their system of communication - the human language to be unique. But what is it that makes the human language so special and unique?

Four major criteria have been proposed by Professor Franz Schmalhofer from the University of Osnabrück as explained below:

- **Semanticity**
- **Displacement**
- **Creativity**
- **Structure Dependency**

**Semanticity** means the usage of symbols. Symbols can either refer to objects or to relations between objects. In the human language words are the basic form of symbols. For example the word "book" refers to an object made of paper on which something might be written. A relation symbol is the verb "to like" which refers to the sympathy of somebody to something or someone.

The criterion of **displacement** means that not only objects or relations at presence can be described but there are also symbols which refer to objects in another time or place. The word "yesterday" refers to day before and objects mentioned in a sentence with "yesterday" refer to objects from another time than the present one. Displacement
about the communication of events which had happened or will happen and the objects belonging to that event.

Having a range of symbols to communicate these symbols can be newly combined. Creativity is the probable most important feature. Our communication is not restricted to a fixed set of topics or predetermined messages. The combination of a finite set of symbols to an infinite number of sentences and meaning. With the infinite number of sentences the creation of novel messages is possible. How creative the human language is can be illustrated by some simple examples like the process that creates verbs from nouns. New words can be created, which do not exist so far, but we are able to understand them.

Examples:

leave the boat on the beach -> beach the boat
keep the aeroplane on the ground -> ground the aeroplane
write somebody an e-mail -> e-mail somebody

Creative systems are also found in other aspects of language, like the way sounds are combined to form new words. i.e. prab, orgu, zabi could be imagined as names for new products.

To avoid an arbitrary combination of symbols without any regular arrangement "true" languages need structure dependency. Combining symbols the syntax is relevant. A change in the symbol order might have an impact on the meaning of the sentence. For example “The dog bites the cat” has obviously a different meaning than “The cat bites the dog” based on the different word arrangement of the two sentences.

Non-Human Language - Animal Communication

Forms of Communication

As mentioned before human language is just one of quite a number of communication forms. Different forms of communication can be found in the world of animals. From a little moth to a giant whale, all animals appear to have the use of communication.

Not only humans use facial expression for stressing utterances or feeling, facial expressions can be found among apes. The expression, for example "smiling" indicates cooperativeness and friendliness in both the human and the ape world. On the other hand an ape showing teeth indicates the willingness to fight.

Posture is a very common communicative tool among animals. Lowering the front part of the body and extending the front legs is a sign of dogs that they are playful whereas lowering the full body is a dog's postural way to show its submissiveness. Postural communication is known in both human and non-human primates.

Besides facial expression, gesture and posture that are found in human communication, there are other communicative devices which are either just noticeable by the sub-consciousness of humans like scent or cannot be found amongst humans like light, colour and electricity. The chemicals which are used for a communicative function are called pheromones. Those pheromones are used to mark territorial or to signal its reproductive readiness. For animals scent is a very important tool which predominates their mating behaviour. Humans are influenced in their mating behaviour by scent as well but there are more factors to that behaviour so that scent is not predominating.

The insects use species-dependent light patterns to signal identity, sex and location. For example the octopus changes colour for signalling territorial defence and mating readiness. In the world of birds colour is wide spread, too. The male peacock has colourful feathering to impress female peahens as a part of mating behaviour. These ways of communication help to live in a community and survive in certain environment.
Characteristic Language Features in Animal Communication

As mentioned above it is possible to describe the uniqueness of human language by four criteria (semanticity, displacement, creativity and structural dependency) which are important devices in the human language to form a clear communication between humans. To see if these criteria exist in animal communication - i.e. if animals possess a "true" language - several experiments with non-human primates were performed. Non-human primates were taught American Sign Language (ASL) and a specially developed token language to detect in how far they are capable of linguistic behaviour. Can semanticity, displacement, creativity and structure dependency be found in non-human language?

Experiments

1. Human language
   In 1948, in Orange Park, Florida, Keith and Cathy Hayes tried to teach English words to a chimpanzee named Viki. She was raised as if she were a human child. The chimpanzee was taught to "speak" easy English words like "cup". The experiment failed since with the supralaryngal anatomy and the vocal fold structure that chimpanzees have it is impossible for them to produce human speech sounds. The failure of the Viki experiment made scientists wonder how far are non-human primates able to communicate linguistically.

2. Sign language
   From 1965 to 1972 the first important evidence showing rudiments of linguistic behaviour was "Washoe", a young female chimpanzee. The experimenters Allen and Beatrice Gardner conducted an experiment where Washoe learned 130 signs of the American Sign Language within three years. Showing pictures of a duck to Washoe and asking WHAT THAT? she combined the symbols of WATER and BIRD to create WATER BIRD as she had not learned the word DUCK (the words in capital letters refer to the signs the apes use to communicate with the experimenter).

   It was claimed that Washoe was able to arbitrarily combine signs spontaneously and creatively. Some scientists criticised the ASL experiment of Washoe because they claimed that ASL is a loose communicative system and strict syntactic rules are not required. Because of this criticism different experiments were developed and performed which focus on syntactic rules and structure dependency as well as on creative symbol combination.

   A non-human primate named "Kanzi" was trained by Savage-Rumbaugh in 1990. Kanzi was able to deal with 256 geometric symbols and understood complex instructions like GET THE ORANGE THAT IS IN THE COLONY ROOM. The experimenter worked with rewards.

   A question which arose was whether these non-human primates were able to deal with human-like linguistic capacities or if they were just trained to perform a certain action to get the reward.

   For more detailed explanations of the experiments see The Mind of an Ape [3].

Can the characteristic language features be found in non-human communication?

Creativity seems to be present in animal communication as amongst others Washoe showed with the creation of WATER BIRD for DUCK. Although some critics claimed that creativity is often accidental or like in the case of Washoe’s WATER BIRD the creation relays on the fact that water and bird were present. Just because of this presence Washoe invented the word WATER BIRD.

In the case of Kanzi a certain form of syntactic rules was observed. In 90% of Kanzi’s sentences there was first the invitation to play and then the type of game which Kanzi wanted to play like CHASE HIDE, TICKLE SLAP and GRAB SLAP. The problem which was observed was that it is not always easy to recognise the order of signs. Often facial expression and hand signs are performed at the same time. One ape signed the sentence I LIKE COKE by hugging itself for "like" and forming the sign for "coke" with its hands at the same time. Noticing an order in this sign sentence was not possible.

A certain structural dependency could be observed at Kanzi’s active and passive sentences. When Matata, a fellow chimpanzee was grabbed Kanzi signed GRAB MATATA and when Matata was performing an action such as biting Kanzi produced MATATA BITE. It has not yet been proved that symbolic behaviour is occurring. Although there are plenty evidences that creativity and displacement occur in animal communication some critics claim that these
evidences can be led back to dressage and training. It was claimed that linguistic behaviour cannot be proved as it is more likely to be a training to correctly use linguistic devices. Apes show just to a little degree syntactic behaviour and they are not able to produce sentences containing embedded structures. Some linguists claim that because of such a lack of linguistic features non-human communication cannot be a "true" language. Although we do not know the capacity of an ape's mind it does not seem that the range of meanings observed in ape's wild life approach the capaciousness of semanticity of human communication. Furthermore apes seem not to care much about displacement as it appears that they do not communicate about imaginary pasts or futures.

All in all non-human primate communication consisting of graded series of communication shows little arbitrariness. The results with non-human primates led to a controversial discussion about linguistic behaviour. Many researchers claimed that the results were influenced by dressage.

For humans language is a communication form suited to the patterns of human life. Other communication systems are better suited for fellow creatures and their mode of existence.

Now that we know that there is a difference between animal communication and human language we will see detailed features of the human language.

Language Comprehension & Production

Language features – Syntax and Semantics

In this chapter the main question will be "how do we understand sentences?". To find an answer to that problem it is necessary to have a closer look at the structure of languages. The most important properties every human language provides are rules which determine the permissible sentences and a hierarchical structure (phonemes as basic sounds, which constitute words, which in turn constitute phrases, which constitute sentences, which constitute texts). These feature of a language enable humans to create new unique sentences. The fact that all human languages have a common ground even if they developed completely independent from one another may lead to the conclusion that the ability to process language must be innate. Another evidence of a inborn universal grammar is that there were observations of deaf children who were not taught a language and developed there own form of communication which provided the same basic constituents. Two basic abilities human beings have to communicate is to interpret the syntax of a sentence and the knowledge of the meaning of single words, which in combination enables them to understand the semantic of whole sentences. Many experiments have been done to find out how the syntactical and semantical interpretation is done by human beings and how syntax and semantics works together to construct the right meaning of a sentence. Physiological experiments had been done in which for example the event-related potential (ERP) in the brain was measured as well as behavioristic experiments in which mental chronometry, the measurement of the time-course of cognitive processes, was used. Physiological experiments showed that the syntactical and the semantical interpretation of a sentence takes place separately from each other. These results will be presented below in more detail.

Physiological Approach

Semantics

Semantical incorrectness in a sentence evokes an N400 in the ERP The exploration of the semantic sentence processing can be done by the measurement of the event-related potential (ERP) when hearing a semantical correct sentence in comparison to a semantical incorrect sentence. For example in one experiment three reactions to sentences were compared:

Semantically correct: "The pizza was too hot to eat." Semantically wrong: "The pizza was too hot to drink." Semantically wrong: "The pizza was too hot to cry."

In such experiments the ERP evoked by the correct sentence is considered to show the ordinary sentence processing. The variations in the ERP in case of the incorrect sentences in contrast to the ERP of the correct sentence show at
what time the mistake is recognized. In case of semantic incorrectness there was observed a strong negative signal about 400ms after perceiving the critical word which did not occur, if the sentence was semantically correct. These effects were observed mainly in the parietal and central area. There was also found evidence that the N400 is the stronger the less the word fits semantically. The word “drink” which fits a little bit more in the context caused a weaker N400 than the word “cry”. That means the intensity of the N400 correlates with the degree of the semantic mistake. The more difficult it is to search for a semantic interpretation of a sentence the higher is the N400 response.

Syntax
To examine the syntactical aspects of the sentence processing a quite similar experiment as in the case of the semantic processing was done. There were used syntactical correct sentences and incorrect sentences, such as (correct:) “The cats won’t eat...” and (incorrect:) “The cats won’t eating...”. When hearing or reading a syntactical incorrect sentence in contrast to a syntactical correct sentence the ERP changes significantly on two different points of time. First of all there a very early increased response to syntactical incorrectness after 120ms. This signal is called the ‘early left anterior negativity’ because it occurs mainly in the left frontal lobe. This advises that the syntactical processing is located amongst others in Broca's area which is located in the left frontal lobe. The early response to syntactical mistakes also indicates that the syntactical mistakes are detected earlier than semantic mistakes.

The other change in the ERP when perceiving a syntactical wrong sentence occurs after 600ms in the parietal lobe. The signal is increasing positively and is therefore called P600. Possibly the late positive signal is reflecting the attempt to reconstruct the grammatical problematic sentence to find a possible interpretation.

To summarize the three important ERP-components: First of all there occurs the ELAN at the left frontal lobe which shows a violation of syntactical rules. After it follows the N400 in central and parietal areas as a reaction to a semantical incorrectness and finally there occurs a P600 in the parietal area which probably means a reanalysis of the wrong sentence.

Behavioristic Approach – Parsing a Sentence
Behavioristic experiments about how human beings parse a sentence often use syntactically ambiguous sentences. Because it is easier to realize that sentence-analysing mechanisms called parsing take place when using sentences in which we cannot automatically constitute the meaning of the sentence. There are two different theories about how humans parse sentences. The syntax-first approach claims that syntax plays the main part whereas semantics has only a supporting role, whereas the interactionist approach states that both syntax and semantics work together to determine the meaning of a sentence. Both theories will be explained below in more detail.

The Syntax-First Approach of Parsing
The syntax-first approach concentrates on the role of syntax when parsing a sentence. That humans infer the meaning of a sentence with help of its syntactical structure (Kako and Wagner 2001) can easily be seen when considering Lewis Carroll’s poem ‘Jabberwocky’:

"Twas brillig, and the slithy toves Did gyre and gimble in the wabe: All mimsy were the borogoves, And the mome raths outgrabe."

Although most of the words in the poems have no meaning one may ascribe at least some sense to the poem because of its syntactical structure.

There are many different syntactic rules that are used when parsing a sentence. One important rule is the principle of late closure which means that a person assumes that a new word he perceives is part of the current phrase. That this principle is used for parsing sentences can be seen very good with help of a so called garden-path sentence. Experiments with garden-path sentences have been done by Frazier and Fayner 1982. One example of a garden-path sentence is: "Because he always jogs a mile seems a short distance to him." When reading this sentence one first wants to continue the phrase “Because he always jogs” by adding “a mile” to the phrase, but when reading further one realizes that the words ‘a mile’ are the beginning of a new phrase. This shows that we parse a sentence by trying to add new words to a phrase as long as possible. Garden-path sentences show that we use the principle of late closure
as long it makes syntactically sense to add a word to the current phrase but when the sentence starts to get incorrect semantics are often used to rearrange the sentence. The syntax-first approach does not disregard semantics. According to this approach we use syntax first to parse a sentence and semantics is later on used to make sense of the sentence.

Apart from experiments which show how syntax is used for parsing sentences there were also experiments on how semantics can influence the sentence processing. One important experiment about that issue has been done by Daniel Slobin in 1966. He showed that passive sentences are understood faster if the semantics of the words allow only one subject to be the actor. Sentences like "The horse was kicked by the cow." and "The fence was kicked by the cow." are grammatically equal and in both cases only one syntactical parsing is possible. Nevertheless the first sentence semantically provides two subjects as possible actors and therefore it needs longer to parse this sentence. By measuring this significant difference Daniel Slobin showed that semantics play an important role in parsing a sentence, too.

The Interactionist Approach of Parsing

The interactionist approach ascribes a more central role to semantics in parsing a sentence. In contrast to the syntax-first approach, the interactionist theory claims that syntax is not used first but that semantics and syntax are used simultaneously to parse the sentence and that they work together in clarifying the meaning. There have been made several experiments which provide evidence that semantics are taking into account from the very beginning reading a sentence. Most of these experiments are working with the eye-tracking techniques and compare the time needed to read syntactical equal sentences in which critical words cause or prohibit ambiguity by semantics. One of these experiments has been done by John Trueswell and coworkers in 1994. He measured the eye movement of persons when reading the following two sentences:
The defendant examined by the lawyer turned out to be unreliable. The evidence examined by the lawyer turned out to be unreliable. He observed that the time needed to read the words "by the lawyer" took longer in case of the first sentence because in the first sentence the semantics first allow an interpretation in which the defendant is the one who examines, while the evidence only can be examined. This experiment shows that the semantics also play a role while reading the sentence which supports the interactionist approach and argues against the theory that semantics are only used after a sentence has been parsed syntactically.

Inferences Creates Coherence

Coherence is the semantic relation of information in different parts of a text to each other. In most cases coherence is achieved by inference; that means that a reader draws information out of a text that is not explicitly stated in this text. For further information the chapter [Neuroscience of Text Comprehension] should be considered.

Situation Model

A situation model is a mental representation of what a text is about. This approach proposes that the mental representation people form as they read a story does not indicate information about phrases, sentences, paragraphs, but a representation in terms of the people, objects, locations, events described in the story (Goldstein 2005, p. 374)
For a more detailed description of situation models, see [Situation Models]
**Using Language**

Conversations are dynamic interactions between two or more people (Garrod & Pickering, 2004 as cited in Goldstein 2005). The important thing to mention is that conversation is more than the act of speaking. Each person brings in his or her knowledge and conversations are much easier to process if participants bring in shared knowledge. In this way, participants are responsible of how they bring in new knowledge. H.P. Grice proposed in 1975 a basic principle of conversation and four “conversational maxims.” His cooperative principle states that “the speaker and listener agree that the person speaking should strive to make statements that further the agreed goals of conversation.” The four maxims state the way of how to achieve this principle.

1. **Quantity**: The speaker should try to be informative, no over-/underinformation.
2. **Quality**: Do not say things which you believe to be false or lack evidence of.
3. **Manner**: Avoiding being obscure or ambiguous.
4. **Relevance**: Stay on topic of the exchange.

An example of a rule of conversation incorporating three of those maxims is the given-new-contract. It states that the speaker should construct sentences so that they include given and new information. (Haviland & Clark, 1974 as cited in Goldstein, 2005). Consequences of not following this rule were demonstrated by Susan Haviland and Herbert Clark by presenting pairs of sentences (either following or ignoring the given-new-contract) and measuring the time participants needed until they fully understood the sentence. They found that participants needed longer in pairs of the type:

<table>
<thead>
<tr>
<th>We checked the picnic supplies.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The beer was warm.</td>
</tr>
<tr>
<td>Rather than:</td>
</tr>
<tr>
<td>We got some beer out of the trunk.</td>
</tr>
<tr>
<td>The beer was warm.</td>
</tr>
</tbody>
</table>

The reason that it took longer to comprehend the second sentence of the first pair is that inferencing has to be done (beer has not been mentioned as being part of the picnic supplies). (Goldstein, 2005, p.377-378)

**Language, Culture and Cognition**

In the parts above we saw that there has been a lot of research of language, from letters through words and sentences to whole conversations. Most of the research described in the parts above was processed by English speaking researchers and the participants were English speaking as well. Can those results be generalised for all languages and cultures or might there be a difference between English speaking cultures and for example cultures with Asian or African origin?

Imagine our young man from the beginning again: Knut! Now he has to prepare a presentation with his friend Chang for the next psychology seminar. Knut arrives at his friend’s flat and enters his living-room, glad that he made it there just in time. They have been working a few minutes when Chang says: "It has become cold in here!" Knut remembers that he did not close the door, stands up and..."stop! What is happening here?!"

This part is concerned with culture and its connection to language. Culture, not necessarily in the sense of "high culture" like music, literature and arts but culture is the "know-how" a person must have to tackle his or her daily life. This know-how might include high culture but it is not necessary.

**Culture and Language**

Scientists wondered in how far culture affects the way people use language. In 1991 Yum studied the indirectness of statements in Asian and American conversations. The statement "Please shut the door” was formulated by Americans in an indirect way. They might say something like "The door is open” to signal that they want to door to be shut.
Even more indirect are Asian people. They often do not even mention the door but they might say something like "It is somewhat cold today". Another cultural difference affecting the use of language was observed by Nisbett in 2003 in observation about the way people pose questions. When American speaker ask someone if more tea is wanted they ask something like "More tea?". Different to this Asian people would ask if the other one would like more drinking as for Asians it seems obvious that tea is involved and therefore mentioning the tea would be redundant. For Americans it is the other way round. For them it seems obvious that drinking is involved so they just mention the tea.

This experiment and similar ones indicate that people belonging to Asian cultures are often relation orientated. Asians focus on relationships in groups. Contrasting, the Americans concentrate on objects. The involved object and its features are more important than the object's relation to other objects. These two different ways of focusing shows that language is affected by culture.

A experiment which clearly shows these results is the mother-child interaction which was observed by Fernald and Morikawa in 1993. They studied mother-child talk of Asian and American mothers. An American mother trying to show and explain a car to her child often repeated the object "car" and wants the child to repeat it as well. The mother focuses on the features of the car and labels the importance of the object itself. The Asian mother shows the toy car to her child, gives the car to the child and wants it to give the car back. The mother shortly mentions that the object is a car but concentrates on the importance of the relation and the politeness of giving back the object.

Realising that there are plenty differences in how people of different cultures use language the question arises if languages affects the way people think and perceive the world.

What is the connection between language and cognition?

Sapir-Whorf Hypothesis

In the 1950's Edward Sapir and Benjamin Whorf proposed the hypothesis that the language of a culture affects the way people think and perceive. The controversial theory was question by Elenor Rosch who studied colour perception of Americans and Danis who are members of an stone-age agricultural culture in the Iran. Americans have several different categories for colour as for example blue, red, yellow and so on. Danis just have two main colour categories. The participants were ask to recall colours which were shown to them before. That experiment did not show significant differences in colour perception and memory as the Sapir-Whorf hypothesis presumes.

Categorical Perception

Nevertheless a support for the Sapir-Whorf hypothesis was Debi Roberson's demonstration for *categorical perception* based on the colour perception experiment by Rosch. The participants, a group of English-speaking British and another group of Berinmos from New Guinea were ask to name colours of a board with colour chips. The Berinmos distinguish between five different colour categories and the denotation of the colour names is not equivalent to the British colour denotation. Apart from these differences there are huge differences in the organisation of the colour categories. The colours named *green* and *blue* by British participants where categorised as *nol* which also covers colours like *light-green*, *yellow-green*, and *dark blue*. Other colour categories differ similarly. The result of Roberson's experiment was that it is easier for British people to discriminate between green and blue whereas Berinmos have less difficulties distinguishing between Nol and Wap. The reaction to colour is affected by language, by the vocabulary we have for denoting colours. It is difficult for people to distinguish colours from the same colour category but people have less trouble differentiating between colours from different categories. Both groups have categorical colour perception but the results for naming colours depends on how the colour categories were named. All in all it was shown that categorical perception is influenced by the language use of different cultures.

These experiments about perception and its relation to cultural language usage leads to the question whether thought is related to language with is cultural differences.
Is thought dependent on, or even caused by language?

Historical theories

An early approach was proposed by J.B. Watson's in 1913. His peripheralist approach was that thought is a tiny not noticeable speech movement. While thinking a person performs speech movements as he or she would do while talking. A couple year later, in 1921 Wittgenstein poses the theory that the limits of a person's language mean the limits of that person's world. As soon as a person is not able to express a certain content because of a lack of vocabulary that person is not able to think about those contents as they are outside of his or her world. Wittgenstein's theory was doubted by some experiments with babies and deaf people.

Present research

To find some evidence for the theory that language and culture is affecting cognition Lian-hwang Chiu designed an experiment with American and Asian children. The children were asked to group objects in pairs so that these objects fit together. On picture that was shown to the children there was a cow, a chicken and some grass. The children had to decided which of the two objects fitted together. The American children mostly grouped cow and chicken because of group of animals they belong to. Asian children more often combined the cow with the grass as there is the relation of the cow normally eating grass.

In 2000 Chui repeated the experiment with words instead of pictures. A similar result was observed. The American children sorted their pairs taxonomically. Given the words "panda", "monkey" and "banana" American children paired "panda" and monkey". Chinese children grouped relationally. They put "monkey" with "banana". Another variation of this experiment was done with bilingual children. When the task was given in English to the children they grouped the objects taxonomically. A Chinese task caused a relational grouping. The language of the task clearly influenced on how to group the objects. That means language may affects the way people think.

The results of plenty experiments regarding the relation between language, culture and cognition let assume that culture affects language and cognition is affected by language. Our way of thinking is influenced by the way we talk and thought can occur without language but the exact relation between language and thought remains to be determined.

References

    Situation_Models_and_Inferencing#Neuropsychology_of_Inferencing

Books

Journals

- Chomsky, N.: Collateral Language. TRANS, Internet journal for cultural sciences.(2003) Nr. 15

Links & Further reading

Cognitive Psychology and Cognitive Neuroscience/Comprehension