Human language is quite difficult to define precisely. Writers on the subject avoid defining it. Neither George Miller nor Steven Pinker define it in their recent books on language for the general reader (Miller, 1991; Pinker, 1994). It is a communication system, but communication systems are common if not universal in animal.

Human language does, however, have characteristic features, which are unique among natural animal communication systems.

Languages combine phonemes into arbitrary symbols we call words. But many possible combinations of phonemes in a language are not acceptable. Each language has its rules about which phonemes may be combined and which may not. For example, /sl/ is not an acceptable combination in English. So even at the level of speech sounds languages behave like rule-governed system. Infants use this fact to learn the boundaries between words (Saffran, 2003).

At the most basic level spoken languages use a subset of speech sounds drawn from more than 100 phonemes that languages use. "Phoneme" [as in telephone from the Greek tele = distant; phon = speech] is the technical name for speech sounds. Letters written between two slashes represent phonemes, like this: /a/, /t/, /gi/, /du/.

Match the examples to the statements about human language
1. Human language uses arbitrary symbols to stand for things
2. Human language uses grammar to combine words
3. Human language can create messages that are new but understandable

Q1A. "Marshall cleaned the spark plugs of his mower with creme rinse" is a sentence you have never seen before, but you understand what happened.
Q1B. "Radar," "flake out," and "palimony" are words created in the last 50 years for new ideas and things.
Q1C. "friendly scared the at people Halloween Caspar party the ghost the" makes little sense even though it is made up of perfectly good words, but they could be rearranged to make a meaningful, grammatical sentence.

Communication is a social process. When you speak, usually you try to communicate with someone else, often to try to affect his/her behavior. The effectiveness of this social process depends on many factors, but one factor is fundamental. The speaker and the listener must share a common base of information. To communicate effectively the speaker and listener must have an implicit (~unspoken) agreement: the speaker takes into account what the listener knows and does not know. This is called the given-new contract (Haviland & Clark, 1974). What the listener already knows and doesn't know puts a limit on what s/he can understand and what the speaker can say that will be effective communication.

Most of us are quite good at adjusting our speech to what the listener knows. For example, people automatically adjust vocabulary and subject matter when speaking to children. People give more detail in giving directions to someone from out of town than to a local who is generally familiar with the area.
Q2. The assistant in the Computer Science Department tells the returning Junior: "You need to go to the Computing Instruction Office in IMU 084"; she tells the new Freshman: "You need to go to the Computing Instruction office. You'll find it in the Memorial Union. Go out the door facing the woods, and turn right. The path leads straight to the Union. Go in the nearest door and down one flight. Then turn to your left. The office is on the left side of the hall." By answering the two students differently, the assistant __.

A. signals old information with grammatical and syntactic cues
B. follows the given-new contract
C. takes into account what her listener knows
D. B and C are both correct

A speaker gives cues to the listener about what is new information and what is old. For effective speaking (and writing) the first part of a sentence or paragraph provides a link to what is old, and the second part gives new information. This leads the listener (or reader) smoothly into the new material.

Q3. A recent article on how to write effectively (Gopan & Swan, 1991) points out an important feature of good writing: The first part of the sentence should give old information to provide context for new information that follows. This idea illustrates ___ in written language.

A. categorical perception
B. the given-new contract
C. bottom-up processing
D. an arbitrary symbol
E. the role of rule structure

The syntactical structure of a sentence can signal what is given and what is new. For example, English speakers automatically put the article "a" before a noun phrase that refers to something new or otherwise not specified. They use the article "the" before a noun phrase that describes something specific, often something already mentioned. For example, one of the most famous opening lines of a novel is: "It was a dark and stormy night." Bulwer-Lytton used "a" because it is not some specific night the reader already knows about. If he had written "It was the dark and stormy night that Cassandra had predicted," he would have used "the" because "that Cassandra had predicted" tells the reader the specific night he was telling about.

Q4. Consider the following micro-story: "Sam found a month-old dish of ham salad in the refrigerator. The ham salad was spoiled, so Sam put the dish in the trash." The first time "dish" appears the article is "a"; the next time, it is "the" because __.

A. the semantic cues tell the reader that new information is coming
B. the past tense had been used already
C. the second time "dish" refers to a specific dish the reader already knows about
D. the story fails to follow the given-new contract
E. grammatical rules define relations among words

The given-new contract can be studied under controlled laboratory conditions. For example, observers are asked to signal as soon as they understand a test sentence flashed on a computer screen. A priming sentence, which does not require a response, precedes the test sentence. If the priming sentence provides a good context for the test sentence, then observers report understanding it more quickly than if the priming sentence doesn't.

For example, the sentence, "We got some beer out of the trunk," is a better prime for the test sentence "The beer was warm" than is the sentence "We checked the picnic supplies." The explicit mention of "some beer" in the first prime speeded reaction of understanding the test sentence (Haviland & Clark, 1974).

Krauss and Glucksberg (1977) showed how the given-new contract guided the development of mutual understanding of new material. Pairs of subjects who could not see each other had sheets of paper with identical sets of shapes having no obvious name. Figure 1-3q shows an example. One observer is the talker; the other is the listener. The talker must explain to the listener which pattern s/he is looking at. On the first trial, the speaker gives a long description, of several features, describing its overall appearance. The talker might say "It looks like an outboard motor," to figure 1-3q as well as other features.

On the second trial, the speaker shortens the description. S/he deletes everything except some overall feature, such as "looks like a motor," because s/he knows from his/her preceding description that the listener now knows something about the patterns. Over the next few trials the description reduces to a word or two, like "motor" because the speaker and

Figure 1-3q. A nameless shape like one Krauss and Glucksberg (1977) used.
Figure 2-3r. Braille alphabet. The black dots represent raised dots or bumps which Braille readers detect by moving their fingertips over them.

<table>
<thead>
<tr>
<th>Alphabet</th>
<th>a</th>
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<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
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<td>Punctuation marks:</td>
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<td></td>
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</tr>
</tbody>
</table>

Source: http://faculty.physics.utoronto.ca/~eckel/braille.html

Q5. Which of the following FAILS to use the given new contract?
A. To drive to Indianapolis, turn left after you pay the parking fee and go up the short hill. Turn right when you get to first the street. When the street ends, turn left. Then right at the second traffic light.
B. Lift the left and right corners and put one on top of the other. Then lift the bottom (corner) and put it on top of them.
C. The instructor explained what osmosis is, before she described how osmoreceptors in the brain control of drinking.
D. In cookbooks, recipes give a list of ingredients before the instruction on what to do.

This link goes to Fields of Linguistics, which provides two dozen short but authoritative articles "to explain the discipline to the general public." It was developed by the Linguistic Society of America, the major U. S. organization of people who study language in all its aspects.

Reading substitutes visual (or in Braille, tactile [touch]) symbols for auditory ones. Languages like English, Russian, Hebrew, and Arabic use letters -- symbols that (roughly) stand for speech sounds. (Other written languages like Chinese use symbols that stand for words.) You can read words written with letters in two ways. In phonetic decoding, you "sound out" words, which means you break down the written words into the speech sounds the letters stand for. Once you know a word, you can read it by whole word recognition. Children beginning to learn to read are often taught to use phonetic decoding. As they become more experienced and know many words by sight, they switch to whole word recognition.

Phonetic decoding has the advantage of almost always working. It works less well in English than most other languages, because English has many irregularly spelled words. For examples: "Tear" [as in cry] and "tear" [as in rip] are spelled the same but are pronounced differently. "Tare" [as in weigh] is spelled differently but is pronounced the same as "tear" [rip]. "Read" [present tense], "read" [past tense], and "red" show the same pattern.

Phonetic coding has two disadvantages:
1. Because each letter is read separately, phonetic coding must be much slower
2. Because it requires conscious attention and controlled processing, phonetic coding competes for the limited cognitive resources of working memory with recoding and other processes required from understanding meaning.

Whole word recognition has the big advantage of being automatic, so it is fast and efficient and it puts few demands on working memory's limited resources. The disadvantage of whole word recognition is that the reader must know the word to read it. Efficient readers have to use both whole word recognition and phonetic decoding. They use whole word recognition for familiar words and phonetic decoding for unfamiliar ones.
Q1. For an experienced reader, the letters c-a-t trigger the meaning of the word without any conscious mental effort. In contrast, a new reader sounds out each letter to figure out what word the letters stand for. The experienced reader can use ____; the new reader uses ____.
A. implicit memory; explicit memory  B. a mnemonic system; a rote rehearsal system
C. automatically without using much of working memory's capacity; controlled processing  D. whole word recognition; phonetic decoding  E. C and D are both correct.

A reader must recode information into fewer and larger chunks as s/he reads. Otherwise, the reader's working memory cannot hold the first part of a sentence to connect it to later parts. This is why unfamiliar material or long, complex sentences are hard to read. Recoding such material is difficult, so readers easily lose the meaning of the first part before they finish the last part. Skilled readers use their working memories more effectively, because they can recode information more efficiently. By combining information into larger chunks, skilled readers have a better chance to keep information available as they continue reading a sentence.

Q2. Many individual sentences and all paragraphs have more than seven words. To read paragraphs and longer sentences, you must
A. memorize the information to put it into procedural memory  B. recode the words and phrases into larger chunks because of working memory's limited capacity  C. prime the meaning of each word to activate its meaning into working memory  D. use a mnemonic to cue the meaning into working memory because it uses only controlled processing  E. A and D are both correct.

Good readers move their eyes systematically through the text material they read. The eyes fixate (stop and look straight at) on a word for as little as 1/5 second before the eyes make a saccade (~jump) 1-3 words to the right on the line of text to make the next fixation. Figure 2-3r illustrates the saccades and fixations a good reader makes reading text.

The eyes fixate longer on difficult words, and move backwards when a word is unfamiliar or too long, or when it is unexpected. The sentence in Figure 3-3r illustrates this. The phrase “the thief stood before the judge” suggests that “before” means “in front of,” because that's what most readers will expect. But “entered” makes this meaning not fit, so the reader goes back to check the word. The reader must figure out the meaning “earlier in time” for “before” before continuing.

Figure 3-3r. Saccades and fixations: The grey-brown line shows the path the eye takes reading the text. The blue line at the top shows the position of the eye as it moves from left to right (upwards). The horizontal parts show fixations; the brief rising parts show saccades. The saccades jump the eye to “free,” “where,” and “ever.” The green line at the bottom is the derivative of the blue lines. The upward blips show the saccades; the large downward swing at the right end is the eye moving to the beginning of the next line of text.

All free men, where ever they may live, are citizens of Berlin and therefore, as a free man I take pride in the words: Ich bin ein Berliner.

Source: http://www.smi.de/at/index.html

Good readers move their eyes differently while reading than do poorer readers. They:
! make shorter fixations on words.
! use less phonetic decoding.
! retrace eye movements less often.
! spend less time on function words (prepositions, conjunctions, etc. that connect other words) than on content words (nouns, verbs, adjectives, etc., which refer to something outside the sentence itself),
! identify and spend extra time on the more important words in a sentence. Speed readers are especially good at this.
They read this way because they use whole word processing a lot and recode more efficiently than do poor readers. For more information about eye movements and reading, click HERE.

Match the following reading traits with the kind of reader that shows them: **P** = poor; **G** = good

| **Q3A.** | spend less time looking at individual words | **P** | **G** |
| **Q3B.** | detect the words that carry the most information and look at them longer | **P** | **G** |
| **Q3C.** | usually figure out what words are by "sounding out" to get the words' individual speech sounds | **P** | **G** |
| **Q3D.** | save what they read in long-term memory without recoding it | **P** | **G** |
| **Q3E.** | retrace fixations (right to left) only for long, unfamiliar, or unexpected words | **P** | **G** |

**Dyslexia.** Some children have a lot of difficulty learning to read though they are normal on other measures of mental function. This disorder is called developmental dyslexia. Early in this century, physicians reported several case reports on dyslexic children's writing. These children's writing was very messy, as illustrated in Figure 5-3r, and had systematic errors in spelling: reversing and writing many letters backwards. In addition their eye movements seemed abnormal when they tried to read.

These case reports, taken together, showed correlations among abnormal eye movement problems, poor writing, and poor reading. They were interpreted as evidence for a visual perceptual deficit. According to this idea children had trouble reading and writing because they had problems making or putting together the parts of letters into the full letter (Stanovich, 1998). This idea was the basis of treatment programs for dyslexia aimed at "perceptual re-education." It emphasized ways to improve the children's perceptual coordination and eye-hand coordination.

Recall that case studies rarely provide adequate evidence for causation, because the observations they report have so many possible explanations. Many of you will also recall that correlations seldom demonstrate causation. For example, the abnormal eye movements may be the result of reading problems, not their cause.

For many years, no well controlled studies tested whether people with dyslexia really had visual perceptual defects. The visual deficit explanation persisted until well-controlled studies by psychologists, physiologists, and reading specialists found much more valid explanations of the deficits underlying dyslexia. As one might expect, several factors contribute to reading problems, including difficulty in hearing speech sounds and in audio-visual recoding.

Physicians are still responsible for diagnosing developmental dyslexia for most legal purposes, though they have no particular research training or expertise in this area. In contrast, psychologists and other who study reading have both. This fact probably reflects the social and legal status and public awareness of physicians and of reading specialists.

Q4. Case studies and correlations provided the data used to conclude that dyslexia reflected a perceptual deficit. This was an invalid conclusion to draw from these data because

A. the messy writing and letter reversals may be an effect of dyslexia rather than a cause
B. case studies and correlations can rarely identify causes
C. case studies and correlations are not scientific
D. A and B are both correct
E. A, B, and C are all correct

Well-controlled research has since demonstrated the role of several processes in dyslexia. This research again shows how important carefully designed research is to draw valid conclusions. The brains of people with developmental dyslexia have been studied using a variety of methods. Figure 6-3s shows a PET scan of the left cerebral hemisphere from a person with dyslexia. When this person was reading, Wernicke's area in the angular gyrus (AG) showed abnormally low activity. This area plays an essential role in language recognition.

Wernicke's area has also been examined microscopically in specially treated brains from people with dyslexia. These brains showed abnormal organization of this part of the cerebral
cortex (Kemper, 1984). Normally, neurons in the cerebral cortex are neatly arranged in six main layers (see asgn2d). 

**Figure 6-3r.** PET scan of the left cerebral hemisphere from a person with dyslexia. AG (angular gyrus) shows the location of abnormally low activity in Wernicke's area when this person was reading.

These layers are disorganized in brains from dyslexic people, indicating abnormal function. Other experiments (Vellutino, 1987) compared two hypotheses about dyslexia:

- The original perceptual deficit hypothesis: Dyslexia reflects a difficulty in seeing or recognizing letters or words. If you can't perceive letters or words well, you will have difficulty reading.
- A newer coding deficit hypothesis: Dyslexia reflects a difficulty in mapping sounds onto a vision code. If you cannot make the relation between speech sounds with the written form, then you will have a lot of difficulty reading.

This research found that the dyslexic and non-dyslexic children he tested could learn the relation between pairs of visual patterns equally well, even under conditions intended to mix up the children. Clearly, **these dyslexic children were not deficient in this kind of visual perception.**

However, when the children learned connections between visual and auditory signals, the children with dyslexia learned much more slowly than did the non-dyslexic children. This result indicates that the defect underlying dyslexia is probably in the link between auditory and visual codes than in perception itself.

Recently Talal and Merzenich (1997) and others have shown that another factor probably contributes to dyslexia. They showed that **children with dyslexia have difficulty decoding phonetic cues,** especially ones that depend on small time differences, like the contrast between /ba/ and /pa/. This pair of phonemes differs in only one feature: voice onset time. The sound /ba/ has no delay in the onset of vocal cord vibrations; /pa/ has a very brief delay (normally about 65 milliseconds) in the onset of vocal cord vibrations. Tallal and Merzenich's sample of dyslexic children could not detect this small difference in voice onset time, so they could not hear the difference between the two speech sounds. They had this problem with all speech sounds that require detection of very small time differences. For more information about speech sounds, click HERE.

This deficit fits with another recent finding about dyslexic children. They **have difficulty understanding spoken language** as well as reading. They often have difficulty in recognizing that speech can be broken down into phonetic units. So they have difficulty recognizing individual speech sounds in words. Using the first letter of well-known words to point out speech sounds (as Sesame Street does) is probably not very effective with them, because they cannot detect the difference.

Talal and Merzenich developed a treatment program to help these children learn to detect small time differences in speech sounds. They artificially increased the small time differences until the dyslexic children could learn the difference. After they learned this task, the delay was slowly reduced until it was the normal value. With this sort of training on several different consonant pairs, the children's listening and reading performance improved markedly. This is another example of the application of instrumental conditioning to a behavior problem.

**Q5.** [Mark EACH item True (T) or False (F)] Developmental dyslexia has been associated with

- **A.** difficulty learning to read (T)
- **B.** defects in hearing differences between related phonemes (F)
- **C.** poor coding between visual patterns and syllables (F)
- **D.** abnormalities in brain areas associated with language (T)
- **E.** deficits in matching pairs of visual patterns (F)
- **F.** deficits in hearing small time differences in sounds (F)

Link to an article about the debate over this way to treat dyslexia.
Link to an article about dyslexia from the National Institutes of Health.
Link to an article about brain imaging and learning disabilities.
Link to an article summarizing current views of dyslexia.
Grammar is required for producing and understanding language. Chomsky (1959) pointed this out in a 100-page "review" of B. F. Skinner's book *Verbal Behavior* (1957), which took an instrumental learning approach to language. With this paper Chomsky established made grammar, what it does, how it works, and how it develops, the fundamental problem for linguistics (the study of languages, in general) to address. The core of his claim is that grammar is a universal, built-in property of the human mind and brain, that is fundamental to all of human language and communication (Hauser et al, 2002).

Chomsky's basic point is this: **Understanding the meaning of language requires much more than understanding the meaning of individual words.** The words must be combined into phrases and sentences according to the grammar of the language. All languages have a grammar, and no language is "superior" to any other, though some languages may be able to express some kinds of ideas more efficiently than can others (see asgn3v).

**Grammar refers to the set of rules used to combine symbols into meaningful sequences.** Several kinds of grammar apply to language. **Generative grammar** refers to the (unconscious) rules people use to combine words into grammatically acceptable sentences.

Generative grammar is not the same as the stylistic or prescriptive grammar taught in school. This is a particular version, which is socially defined as "correct." "Good" grammar is good not because it communicates any better, but because it has been socially defined as the standard. "Bad" grammar is about as effective at communicating, especially in communities that uses that "bad" grammar.

**Grammatical relations can be signaled in many ways.** The English language uses word order very heavily, but other features also play an important role. Most other languages, like German and Latin, depend much more on inflections ("endings") to signal grammatical relations. Words in such languages change, often in their endings, to signal how they are used in a sentence.

For example, in the English sentence "The man bites the dog," word order tells which word is the subject and which is the object. In German, it is the ending. "Der Man beisst den Hund" is equivalent (except for emphasis) to "Den Hund beisst der Man," in saying "Man bites dog." "Den" signals object and "Der" signals subject.

Q1. In the sentence, "The dog licked the girl with the scarf," you know that the dog was the actor (subject), that the girl received the action (object), and that the action (verb) was licking because

| A. the position of "dog" signals that it is the subject |
| B. the position of "girl" signals that it is the object |
| C. the suffix "ed" at the end of "lick" shows that it is a verb in the past tense |
| D. A, B, and C are all correct |

**Words are divided into two broad grammatical classes:**

1. **content words** (also called *open class* words) are nouns, verbs, and (most) adjectives and adverbs. English has hundreds of thousands of such words, and new ones are added every day (hence, the alternative name, open class). They carry meaning, which means that they refer to something in the world. "Dog" stands for a furry animal that barks and wags its tail. "Beauty" stands for the idea expressed in a freshly opened rose or a figure skater's grace.

2. **function words** (also called *closed class* words) include prepositions, articles, and other words that have meaning through showing the relation between
content words. In the phrase “the girl on the swing,” on indicates a relation between “girl” and “swing.” They are limited to a few hundred, and no new ones are added (hence the alternative name, closed class).

Mark each word below with C if it is a content word or with F if it is a function word.

Q2A. C F scarf  Q2B. C F with  Q2C. C F licked  Q2D. C F dog

The difference between content and function words often appears following brain damage that disturbs language function. Damage in Broca’s area in the left frontal lobe disturbs the use and understanding of function words, leaving content words relatively unaffected. The resulting speech is fragmented into phrases or words, “telegraphic,” not grammatical, but usually meaningful. Figure 1-3s shows left hemisphere with the location of these two areas marked.

Here are two samples of speech that Broca’s aphasic might produce:

“Yes ... Monday ... Dad, and Dad ... hospital, and ... Wednesday, Wednesday, nine o’clock and ... Thursday, ten o’clock ... doctors, two, two ... doctors and ... teeth, yah. And a doctor ... girl, and gums, and I.”

“Me ... build-ing ... chairs, no, no cab-in-ets. One, saw ... then, cutting wood ... working ...”

(Source: http://sun.ling.udel.edu/~kenny/101-rview/ch11_summary.html#wernicke Kenneth Hyde, Dept of Linguistics, University of Delaware.)

Damage in Wernicke’s area in the left parietal and temporal lobes disturbs the use of content words, leaving function words relatively unaffected. The resulting speech is grammatically correct and smooth but “empty,” because it uses few, vague content words or neologisms (made-up words), it often fails to communicate much. Here is a sample of speech by a patient with symptoms of Wernicke’s aphasia (patient’s words in italics):

What kind of work have you done?

We, the kids, all of us, and I, we were working for a long time in the ... you know ... it’s the kind of space, I mean place rear to the spedawn...

Excuse me, but I wanted to know what work you have been doing.

If you had said that, we had said that, poomer, near the fortunate, porpunate, tamppoo, all around the fourth of martz. Oh, I get all confused.

(Source: http://sun.ling.udel.edu/~kenny/101-rview/ch11_summary.html#wernicke Kenneth Hyde, Dept of Linguistics, University of Delaware.)

Mark each item below with B if it is a feature of Broca's aphasia or with W if it is a feature of Wernicke’s aphasia.

Q3A. B W disturbed use of function words
Q3B. B W speech has disrupted grammar, missing connecting words like "on" and "by," but it is meaningful.
Q3C. B W speech is fluent but uses few nouns, verbs, adjectives, and it is largely meaningless.
Q3D. B W damage involving left cerebral hemisphere where parietal and temporal lobes meet.

Compared to content words, function words are harder to learn and harder to recognize and use. The difference between content and function words also appears in reading and language learning. In general, function words appear to be more difficult to process. The following examples illustrate this idea.

! Compared to good readers, poor readers spend more time fixating on (looking directly at) function words.

! Children learn to use function words properly much later than they learn content words.

! Adults learning a new language also find function words (like prepositions) especially tricky to use properly.
Participants learned lists of content word-nonsense syllables pairs (left) and nonsense syllables and function words pairs (middle) or triplets (right). For the function words, they learned triplets better than pairs.

The difference between content and function words appears even in a simple verbal learning task (Glanzer, 1962). Participants learned lists that pair nonsense syllables with either content words or function words, as shown in the left and middle lists in Figure 2-3s. Content words in the vocabulary outnumber function words by about 50 to 1, and function words are used more often than most content words. Both of these properties of function words should make them easier to learn.

Nevertheless, participants learned the pairings with function words more slowly than with content words. Participants also got lists that put function words between two nonsense syllables, as in the right-hand list in Figure 2-3s. This is something like their normal role of connecting "words." In this condition, the difference between content and function words disappears. Putting the function words in their normal place helped the participants learn and/or retrieve them. This finding indicates that grammatical features of function words are part of the way they are saved in long-term memory.

Q4 Function words work differently than do content words. We know this because

T F A. people learn to associate pairs of content words easily, but they learn an function word better if it stands between two content words 
T F B. function are easier to read than are content words because there are so few of them 
T F C. function words are harder to learn than are content words 
T F D. brain damage does not affect understanding or saying function words because there are so few of them

Psychological Reality of Grammar

Grammar is psychologically real, not just a set of arbitrary rules made up by language teachers. This means that grammar affects many different psychological processes, many not tied to language. It does more than say how words must be arranged in a language. It affects how the intended meaning is put into and extracted from a sentence and what that meaning is, how sentences are perceived and how its structure and meaning are remembered. It also affects mental functions outside language.

Many lines of evidence support of this idea:

1. Grammar is universal in human language. All languages, including sign languages that deaf people use, have rules that act like a grammar. Some linguists, like Chomsky, claim that the grammar of every language is a particular expression (~display) of a single, underlying universal grammar. This grammar is supposed to be built into the brain and shaped by experience into different forms for each different language.

2. Grammar is essential for communicating meaning. A set of words in random order communicates very little. The same words organized grammatically can communicate several different meanings depending on the grammatical organization.

3. Grammatical structure can be recognized in a sentence, even if a sentence is semantically anomalous (~doesn't make sense: semantic = meaning; anomalous = ~not fitting, deviant, abnormal). Chomsky created this famous semantically anomalous sentence to illustrate the independence of grammar from vocabulary:

"Colorless green ideas sleep furiously."
The words in this "sentence" don't go together by meaning, but they do go together by grammatical function: ("Colorless" and "green" are adjectives that modify "ideas." "Ideas" by its position must be the subject of the verb "sleep." "Furiously" is an adverb that must modify "sleep.") You can even get this effect with a "sentence" made up of nonsense "words," like the one on p.7, which provides signals of the grammatical function of the "words."

But is that the sentence meaningless? In the literal sense, yes. But it does having meaning as a metaphorically: "Colorless" can mean "bland" (a colorless person is rather dull and doesn't stand out); "green" can mean "new" or "untried"; sleep can mean "quiet," "inactive," or "hidden under the surface." So the sentence, "Colorless green ideas sleep furiously," could be interpreted this way: "Bland, untried ideas are still very active, but remain hidden below the surface of consciousness."

4. Grammar helps understand the words in a grammatical sentence. This effect depends on the constraints (limits) that grammar put on the relations among the individual words. The role of grammar in understanding language can shown in several ways. For example, if people listen to sentences under noisy conditions, they can understand words in a grammatically ordered sentence much more easily than the same words in random order because __. A. grammatical context gives you a good idea of what kind of words can be in each position of a sentence B. function words are more important grammatically than are content words C. prefixes and suffixes modify words' meaning and grammatical category D. words are perceived categorically E. B and D are both correct

5. Grammar affects memory for words and sentences. You use grammatical boundaries between phrases and clauses to recode them to put into memory. We know this because memory fails at grammatical boundaries, not in the middle of a clause or phrase. For example, in one memory experiment, participants got a series of complicated sentences and then tried to recall them word for word. Their recall usually failed at grammatical boundaries (at the end of a clause or phrase). For a sentence like: "The house that burned down last night was the one with the brown roof and yellow walls built by the Thomas family in 1898," memory errors usually occurred at a grammatical boundary, like between "walls" and "built."

In another experiment, participants heard a sentence, and then got a cue word taken from that sentence. Their task was to recall the next word after the cue word. They were more accurate if the cue word and the following target word are in the same grammatical phrase than in different ones. So, if the participants got the example sentence above ("The house that burned..."), they would make more errors if the cue word was "walls" than if it was "yellow". "yellow" and "walls" are in the same phrase, whereas "walls" and "built" are in different ones.

6. Grammar affects how people listen to sentences and recognize words in them. Grammatical boundaries appear to mark "pauses" in recoding. We know this because they "capture" non-speech sounds added into sentences. For example, If participants wearing stereo earphones hear a sentence in one ear and random clicks in the other, they report the clicks occurring at grammatical boundaries, rather than in the middle of words where they actually occurred.
Grammar also affect recognition of words at grammatical boundaries. The same word at the beginning of the last grammatical clause in a sentence is recognized more efficiently than it if comes at the end of the second last, even if the word is equally close to the end of the two sentences.

To show this, Caplan (1972) presenting participants with sentences and asked them to report as quickly as possible whether a sentence contained a target word. Among these sentences were pairs in which the target word was followed by the same words. But one sentence put the target word before a grammatical boundary, whereas the other put the target word after the same boundary. In the following example, “oil” is the target word, and the carat[^] marks the boundary between the two clauses in each sentence.

| A: Now that artists are working fewer hours ^ oil prints are rare. |
| B: Now that artists are working in oil ^ prints are rare. |

Participants identified the target “oil” faster in the A type of sentence, presumably because it was processed as part of the second clause. Therefore it was more recent in memory than was the target word in the B type sentence, which is processed as part of the first clause.

Q6. Grammars have psychological reality. Evidence for this claim comes from the fact that
A. grammatical boundaries perceptually “attract” extra sounds inserted into the sentence
B. grammatical construction makes words easier to identify and understand
C. grammatical boundaries define the chunks of a sentence that people forget
D. grammatical boundaries affect how quickly participants recognize target words
E. all of the above are correct

Linking ideas and language

Transformational Grammar links the deep structure of what you say (the ideas you want to communicate) to the surface structure that you actually say. Spoken and written language is used to communicate ideas. Many researchers believe that the ideas people communicate are the represented in the mind as a set of kernel ideas. These ideas are the deep structure of what we want to say. These ideas are combined and reorganized by a transformational grammar into a surface structure, which are the sentences people actually say or write.

A strong reason for this idea comes from the way people remember sentences. We remember the idea a sentence conveys (its deep structure) much better than its grammatical form (its surface structure). For example, the change from "Tom's coat ripped" to "Tom's coat tore" is less likely to be noticed than to "Tom's coat dripped."

Transformational grammar is very different from the generative grammar used to describe the surface structure of what we actually say or write. The main generative grammatical rules are fairly easy to describe. Transformational grammar is much more complex, and even professional linguists do not understand them well. Nevertheless, many linguists believe that it operates all the time to convert the kernel ideas in the mind into the sentences people actually say.

The idea of a transformational grammar is intended to explain why people automatically recognize sentences as grammatical or ungrammatical, even though they can't say why. For example, which of the four sentences is not "grammatical?" 1. Irv drove the car into the garage. 2. Irv put the car into the garage. 3. Irv drove the car. 4. Irv put the car.

Match the term with the definition
1. surface structure 2. deep structure 3. transformational grammar

Q7A. The idea that a sentence attempts to communicate
Q7B. The actual form that a sentence has
Q7C. The rules that connect the two are a

Non-Grammatical Processes in Language

Other factors besides the grammatical organization of the words tell how words are related in a sentence and what a sentence means. The meaning of words may be needed to clarify the grammar of a sentence. This is especially true in English, which depends so much on word order for grammatical information.
You know the sentence "The dog licked the girl with the red scarf" means that the girl had a red scarf. Grammatically, the sentence could easily mean that the dog used a red scarf to lick the girl, but you know from its meaning that "scarf" is not something you lick with. (In an inflected language like German, grammatical structure alone can make this clear: The dog licked the with the red scarf girl.)

A group of features called the *pragmatics* **communicate a lot of information about meaning**, especially in spoken language. These features are independent of grammar. They include

- *metaphorical meaning* as opposed to the literal meaning of speech (for example, "getting cold feet" has nothing to do with the temperature of your feet, and "Get me a hamburger, and step on it" doesn't say to put your foot onto a hamburger.)

- *emotional content* ("Now class, I mean it" spoken in an expressionless monotone has little effect on a group of 5th graders; it requires clear emotional quality that words and grammar alone cannot convey [~carry].)

- *gesturing to amplify and emphasize the content of speech*. One researcher in brain and language has even proposed that gestures are the evolutionary origins of spoken language (Corballis, 1999).

The *prosody* of the spoken sentences conveys a lot of information in non-grammatical form. Prosody refers to the stress, rhythm and pitch of the speech, which communicates the most of the feeling and emotion that speech conveys. For example, in English, rising pitch at the end of a sentence signals a question, whereas a falling pitch signals a statement.

Prosody also signals the emotional content of the message. For example, higher pitch and stronger stress signals strong emotion. So the sentence "This is the end" can mean a question, if it rises in pitch, a statement if it falls, and a sign of anger or annoyance if it is spoken with strong emphasis, especially on the last and first words. You don't even need to understand the meaning of the words to get the emotional message of speech.

Some meaning is conveyed entirely and only by *prosody*. Sarcasm, which depends entirely prosody, can reverse the literal, grammatically signaled meaning of a spoken sentence. Just the rhythm and pitch changes can stand for a short sentence: Jane asks John, who is deep in the newspaper, "Where's the umbrella?" He responds "Ummm um-um," the second "um" higher and the third lower than the first. It is clearly recognizable as "I dunno" (I don't know).

**Match the example with the idea it fits best**

1. The real meaning of the sentence is unrelated to its grammar  
2. Meaning carried by prosody  
3. Grammatically this sentence can mean two different things  

Q8A. Dilbert blew the last exam away.  
Q8B. I have **NEVER** been so sur---PRISED! in my **LIFE**!  
Q8C. He hit the man with the red hat

By making grammar the central question in the study of language, Chomsky ignored these and other non-grammatical features of spoken language, which plays an essential role in ordinary speech. The overemphasis on grammar resulted in an incomplete appreciation of the richness and complexity of spoken language and probably contributed to some questionable assumptions about the way speech develops in infancy and childhood, which asgn3u describes.

Q9. Grammar is not a full explanation of the way sentences convey meaning, because  
A. grammar cannot explain how metaphors (e.g., "Tiger blew them away with his play") convey meaning  
B. grammar cannot convey the emotional quality of speech  
C. the pragmatics of language convey meaning through prosody, gesture, etc. that grammar often does not.  
D. the grammatical structure of sentences can be clarified by the meaning of words and by prosody.  
E. all of the above are correct
Origins of Language

For an article about the possible evolutionary origins of language from gesturing, click HERE.

Newborn infants do not yet speak or understand words and sentences, but they can recognize phonemes (~speech sounds). As early as you can test them, infants discriminate between phonemes categorically, just as adults do. This means that infants, like adults, have a sharp boundary between sounds that make different phonemes from related pairs. For example, the boundary between two closely related consonants, like /ba/ and /pa/, is quite abrupt rather than gradual.

Eimas et al. (1971) used habituation to show that two-to-three-week-old infants discriminate phonemes categorically. Babies increase sucking as part of their orienting response to new stimuli. Repeating that stimulus decreases orienting as shown by a decline in strength and frequency of the sucking response. To test discrimination of speech sounds, babies heard a computer-generated phoneme combination (like /ba/) repeated over and over until sucking declined. The sound was changed to be a little more like the sound /da/. If the stimulus change crossed the adult boundary between /ba/ and /da/, the baby increased sucking; if it did not, the baby did not increase sucking. This indicates that the baby recognized the difference between speech sounds and has the same boundary between them that adults show.

Infants can detect the difference between two related phoneme pairs that are NOT in the language they hear. The indicates that babies are born with the capacity to discriminate among many more phonemes than they hear, though adults around them cannot. Therefore, babies must lose the capacity to recognize phoneme differences they do not hear.

Q1. Which of the following is the evidence ("fact," observation) showing that very young babies discriminate phonemes categorically?
A. sucking habituated to one speech sound increases only when the sound change crosses a phonetic boundary
B. babies habituate to repeated speech sounds
C. babies make a different speech sound when they have been habituated to one speech sound
D. crossing a boundary between phonemes is the adequate stimulus for habituation
E. B and C are both correct
F. A, B, C, and D are all correct

Older babies are tested for their discrimination of speech sounds using head-turning procedure. In one group of experiments, babies heard a repeating phoneme, e.g., /ba/, which changes a little after several repetitions. If s/he turns the head toward a window just after the change, a mechanical monkey that claps cymbals appears. If the baby can hear the change in speech sound, s/he quickly learns the head turning response to get to see the monkey.

Babies turn the head only if the change crosses the boundary between phonemes. This result shows that babies discriminate between the two speech sounds the way adults do. This result shows categorical perception in these older babies.

At about six months of age, babies start losing the ability to hear phonetic differences they do not hear. This is when the baby starts babbling and making some speech sounds. By one year of age children can no long detect the speech sounds they don’t hear. As in other areas of development, this perceptual capacity exhibits the "use it or lose it" principle.

Match each child with its ability to perceive phonemes [not every alternative needs to be used]. Hint: What phonemes can very young babies hear? After speaking starts?

1. A 3-month-old baby
2. An 18-month-old toddler
3. Both 3-month-old baby and 18-month-old toddler
4. Neither 3-month-old baby nor 18-month-old toddler
Q2A. only phonemes in real words
Q2B. phonemes whether or not in the language environment
Q2C. no phonemes at all
Q2D. only phonemes that their care-givers use

When a baby starts babbling, another change occurs that is important for its language development. This change is in the parents' (care givers') speech directed toward the baby. Until the baby shows signs of
language by babbling and making some of the easier speech sounds, adults often talk to the baby as if it were an adult. When these signs first appear, the caregivers' speech changes dramatically. The vocabulary and grammar become much simpler and the speech itself becomes very clear and slow. The caregivers automatically and quite unconsciously take into account the baby's capacities and needs. (Researchers disagree on this point; some claim that it is not necessary or even helpful because adults in many cultures apparently do not do this.)

**Q3.** Babbling starts at about six months of age. Early babbling contains

A. all possible phonemes

B. easily pronounced phonemes

C. phonemes to which the baby has been habituated

D. no recognizable phonemes (only noises)

When a young child starts to learn the meaning of words, s/he has to associate the word with its referent (what it stands for). When you point to a cup and say the word "cup," you know that you are referring to the class of objects we call cups. But the child does not. S/he may (reasonably) conclude that "cup" is the name of that particular cup, and will not say "cup" in response to any other cup. This is under-extension. On the other hand, the child may generalize "cup" to anything you put liquids into, because that is how s/he sees that cups used. So s/he says "cup" to a glass, a jar, etc. This is over-extension.

At this stage of language learning, toddlers who learn different languages show some significant differences. For example, American toddlers begin by learning nouns more than verbs. The difference between nouns and verbs is much smaller for Korean toddlers. The different patterns reflect what caregivers emphasize when they are teaching words. American caregivers emphasize objects ("Look at the ball, Timmy!"), whereas Korean caregivers emphasize actions ("Look at the ball roll, Iksun!")

**Q4.** When a young child first learns the meaning of a new word, like "cat," s/he may use it as the name of one specific cat. S/he is showing _______. But sometimes she may apply that word to anything showing a salient (standing out) feature of the object used to teach him/her that word (like saying "cat" for anything furry). In this case s/he is showing _______.

A. child directed speech; child directed speech

B. underextension; overextension

C. concrete perception; categorical perception

D. phonetic reasoning; categorical reasoning

E. concrete linguistic functions; conceptual linguistic functions

F. C and E are both correct

When a toddler has developed a small vocabulary, s/he starts putting words together into two-word sequences that follow a "grammar." This "grammar" appears to be the same in all language communities studied. It is unrelated to the grammar of the adult language. Toddlers' "grammar" is so limited apparently because their working memory is even more limited than is an adult's. Also, they have a small vocabulary limited to content words (mostly nouns and some verbs; function words, like prepositions, articles, etc., are absent). Function words are harder to learn because they are really concepts usually describing a relation. So they have less specific referents (~what they stand for), and they are harder to use correctly, as adult learners of foreign languages know.

The second word is usually a noun and the first word is something related to that noun, some action ("read book") or condition ("all-gone ball") or quality ("big truck"). These two-word sequences are rather fixed, showing little of the flexibility of adult grammar. Prosody (~stress and intonation; see asgn3s) and the external situation helps the listener understand the meaning of these two-word "sentences."

**Q5.** Children's first step in learning to put words together by grammatical rules

A. follows the simplest rules of their native language's adult grammar

B. is limited by immature vocabulary and short-term memory to 2-word combinations

C. depends on the adult language they hear (or see, for sign language)

D. depends on knowing how to say all the phonemes in the adult language

E. A and C are both correct

F. A, B, C, and D are all correct
When toddlers first enter the two-word stage, parents and caregivers again start helping the child's further language development. They quite unconsciously begin to teach the grammatical structure of the adult language. They do this by expanding on what the child is trying to say, providing the child with a model of adult grammatical construction. (This process appears universal at least among middle class families; the story for other groups is controversial. Some linguists claim that this form of adult assistance is not universal and not necessary for normal language development.)

Children seem to find the process of language learning very attractive, because they spend a lot of time practicing, both with older people and while alone. When alone they may take a simple sentence and elaborate it in various ways. In the process they discover the syntactic rules that govern the adult language. They discover these rules from examples, not by formal explanation. Formal explanations come much later in school, long after they have mastered the rules for practical use. Speakers who have not studied the grammar of the language they speak are quite unaware of the grammatical rules or how or why they say things in a particular way.

Q6. Joana was born in a Spanish-speaking community, but she went to live in an English-speaking community at age 5. So she studied only English grammar in school. She spoke Spanish fairly well but had absolutely no (conscious) idea of what she did grammatically (she did not study Spanish in school). This means that
A. her parents did not do a good job of teaching her Spanish grammar
B. language learning depends on developing mental models of what a person must say
C. she must have unconsciously discovered the grammatical rules of Spanish for herself
D. she had habituated to the grammar of Spanish as a toddler, so it is now unconscious

Other features of language acquisition occur in a predictable order, on the average. For example, children learn first how to make the past tense of many irregular verbs (go, went), probably because irregular verbs are more common. Because they are irregular, each past tense must be learned individually.

Later, children discover that adding "-ed" makes the past tense of regular verbs. They quickly apply this rule to all verbs, including the irregular ones, to which it doesn't apply. Children seem to regress at this point in their language development, saying "I goed" when they used to say "I went." In fact, it is a sign of progress, using a rule rather than specific memorized past tense forms. Children quickly learn the limit of the rule and return to the correct irregular form.

Q7. After learning to make the past tense of irregular verbs correctly, young children appear to regress; they start putting the regular form, "-ed," on all verbs, not just regular ones. This is actually a step forward in language learning because it (probably)
A. reflects correcting a defect in the language acquisition device
B. shows that the children's short term memory can now hold many words
C. gives children enough grammar to put words together into sentences
D. reflects the discovery and application of a general rule

Children discover the grammar of their language rather than having it taught to them. This fact has led Chomsky and others to conclude that the human mind contains a language acquisition device, which has a universal grammar in it. An extreme form of this idea states that all that language learning does is to set up a couple dozen "switches" in this language acquisition device to generate the grammar of the child's native language. So, the universal grammar becomes shaped into English grammar by exposure to English, Chinese grammar by exposure to Chinese, Hebrew grammar by exposure in Hebrew, etc.

The development of Creole languages also suggests that a universal grammar is built into the brain. Creole languages develop when people from one language community invade the land of people with a different language. Within one generation a new language, containing elements of both, develops. Only children who were born after the language began master it perfectly. In this situation children could not learn the language they developed from adult speakers, because the adults didn't speak it and often did not master it after it developed.

Sign languages used by deaf people to communicate is another example of language that appears to develop almost spontaneously. American Sign Language is about 100 years old. It is an independent language not derived from spoken English. One piece
of evidence for this is the fact that British sign language is quite different from American Sign Language. If they had been derived from spoken English, you would expect quite a few similarities. According to Pinker (1994), a new sign language independent of others developed within a few years in Nicaragua, when deaf people began to have much more contact with each other.

The idea of a universal grammar is based on several facts. The differences between languages seems enormous, especially between languages in different language families (between, for example, English, Japanese, Arabic, and Yoruba, a language of the West African country Nigeria). Yet all languages have certain basic features, including, for example, word classes (noun, adjective, etc.); noun phrases; verb phrases; subject-verb-object sentence form. According to the language acquisition device approach, these similarities reflect the operation of a universal grammar. The very rapid development of Creole languages and sign languages for the deaf provide further support for this idea.

Q8. Children discover the grammar rules for combining words into sentences (rather than having them taught). This suggests to many researchers that

A. the human mind has a built-in language acquisition device
B. the brain is so flexible it can learn anything
C. the brain has special systems which contain the common structure that underlies all languages
D. children are smarter than we give them credit for
E. A and C are both correct

But alternative interpretations are possible. These include:

\[
\text{Languages describe the way the human world is organized, which is basically similar everywhere. Something (subject) acting (verb) on something else (object).}
\]

\[
\text{People may use something like a neural network (asgn2t) rather than a grammar to generate grammatical speech. Neural networks have been taught to perform as if they knew a syntactic rule, like making verbs past tense. It behaved as if it used the rule "ed" \rightarrow past tense (usually), but all it had was interconnections whose strengths have been adjusted by trial and error (or better, trial and success) to behave as if it had this rule.}
\]

\[
\text{Individual words may be tagged with information on how they can and cannot be used. Studies on learning artificial "grammars" also suggest that languages do not need a built-in universal grammar.}
\]

Reber created a set of arbitrary "grammatical" rules which specified "grammatical" and "ungrammatical" combinations of a set of five letters. Simply by studying a sample of "grammatical" and "ungrammatical" groups of letters, subjects could guess much better than chance whether new combinations of letters were "grammatical" or not. Yet they were completely unaware of the rules that created the "grammatical" letter groups. This finding suggests the possibility that real grammars may only look rule-governed.

\[
\text{Grammar learning may reflect instrumental learning for reinforcement in the form of social connection and increased mastery and control are excellent reinforcers for language learning. (rather than the traditional "primary" and learned reinforcers typically used in the animal learning laboratory. Indeed, one reason autistic children fail to learn language normally may be the ineffectiveness of social reinforcement for them (remember that autistic children ignore or actively avoid social contact).}
\]

Q9. Although languages differ a lot in the speech sounds, words, and grammatical structure they use, they also have some very basic similarities. This fact shows that

A. languages are built on a universal system for all languages
B. languages reflects structure of world they try to describe
C. language is based on tagging individual words with how they can be used, not general rules
D. language is based on neural networks that learn to behave as if they had rules programmed in them
E. A, B, C and D all have been proposed

All sides of this argument agree that the human brain is specialized in some way for language acquisition. Although chimpanzees, other higher primates, and even a parrot have been taught simple language-like communication systems, the training requires intensive formal practice and the results are quite modest even compared to the average human 3-year-old's language skills. The question is whether:
human superiority in language learning and use reflects a specialized system in the brain for language, or some more general properties of the human brain that mediate (carry out) language development as well as other mental processes.

The answer to this question is not at all clear. The history of similar arguments suggests that both processes will turn out to contribute. So the proper question becomes, just how do different processes contribute to language development? This is a more difficult task than simply demonstrating that a process does contribute somehow to language development, and it will take much research to get even the outlines of a reasonable answer.

Q10. Children learn to apply correctly (what appear to be) complex rules of grammar. This fact has been used to support the idea that the brain contains a “built-in” language acquisition device. An alternative explanation for this fact is that __.

A. people actually are using simpler word-specific rules
B. have neural networks that learn to act as if they used rules
C. over- and underextension can explain complex grammar
D. adults repeat children’s ungrammatic sentences grammatically
E. children actually hear grammatically correct language
F. A and B are both correct

Link to a website on chimpanzee communication.