

Fromkin 8e

An Introduction to Language

Answer Key

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Chapter 1

What is language?

1 Sound sequences.

Any word which conforms to the sound pattern of English is a correct answer.

For example:

Bliting: *bl* as in *blood*, *iting* as in *lighting*

Krame: *kr* as in *cream*, *ame* as in *aim*

Swirler: *sw* as in *swim*, *irl* as in *girl*, *er* as in *rider*

Kristclean: *kr* as in *cream*, *i* as in *pit*, *st* as in *street*, *clean* as in *clean*

Atla: as in *atlas*

Oxfo: *ox* as in *ox*, *fo* as in *foe*

Existing English words as names of new products are also acceptable; for example, *Kleen* or *Clean* as the name of a laundry soap.

2 Grammaticality judgements.

The following sentences are ungrammatical:

a * *Robin forced the sheriff go.*

The word *to* is missing in front of the verb *go*. The verb *force* requires a *to* infinitive in the embedded clause.

f * *He came a large sum of money by.*

Particles are preposition-like words that occur with verbs such as *look*, as in *look up the number* or *look over the data*. Particles can occur after their direct object: *look the number up*; *look the data over*. True prepositions do not behave this way. *He ran up the stairs* is grammatical, but *he ran the stairs up* is not. The *by* in *he came by a large sum of money* functions as a preposition and may not occur after the direct object.

g * *Did in a corner little Jack Horner sit?*

You cannot turn a statement that begins with a prepositional phrase into a question. While you can form a question from *Little Jack Horner sat in a corner* with *Did little Jack Horner sit in a corner*, you cannot question the sentence *In a corner little Jack Horner sat*.

h * *Elizabeth is resembled by Charles.*

The verb *resemble* does not occur in passive sentences.

k * *It is eager to love a kitten.*

If the pronoun *it* refers to an animate (non-human) thing (e.g. a dog), the sentence is grammatical. If the word *it* is a 'dummy subject', as in *It's easy to*

love a kitten, the sentence is ungrammatical because the adjective *eager* must have a referential subject.

l * *That birds can fly amazes.*

Amaze is a transitive verb; it requires a direct object. Compare *That birds can fly amazes John.*

n * *Has the nurse slept the baby yet?*

The verb *sleep* is intransitive; it cannot take a direct object (in this case, *the baby*).

o * *I was surprised for you to get married.*

The clause following the adjective *surprised* cannot be in the infinitive form, e.g. *to get*.

p * *I wonder who and Mary went swimming.*

This 'question' is derived from the more basic sentence *Someone and Mary went swimming*. The coordinate structure constraint (see Chapter 4 for a mention, but not a complete description) requires coordinate structures to be treated as a whole, not in part. So it is ungrammatical in most, but not all dialects of English, to ask **Who and Mary went swimming* because there is an attempt to question one part, but not the other part, of the coordinate structure. This also explains the ungrammatical nature of **I wonder who and Mary went swimming* with similar caveats about dialectal and idiolectal variation.

q * *Myself bit John.*

Reflexive pronouns like *myself*, *yourself*, *herself*, *themselves*, etc., do not occur as subjects of sentences but only as objects, e.g. *John hurt himself*.

s * *What did Alice eat the toadstool and?*

A *wh* phrase cannot be moved from inside a coordinate structure (e.g. *the toadstool and the fungi*) to form a *wh* question.

(Note that some judgements may vary across dialects.)

3 Onomatopoeic words.

Sample answers:

swish: what you do when you ski

thunk: the sound of a baseball hitting a mitt

scrunge: the sound of a sponge wiping a table

glup: the sound made when you swallow

squeeng: the sound made when you pluck a taut elastic band.

4 Non-arbitrary and arbitrary signs.

Sample answers:

a Non-arbitrary signs:

a picture of a knife and fork indicating a restaurant

the wheelchair sign that indicates disabled persons, such as used to reserve parking

'No Smoking' sign with a slash through a burning cigarette

'Do not iron' sign on clothes depicting an iron with an X through it.

b Arbitrary signs:

some gestures (e.g., a thumbs-up or a thumbs-down)

stripes on military uniforms to represent different ranks

a black armband for someone in mourning

mathematical symbols (+, - , = , < , > , etc.).

5 Learning.

The first statement (*I learnt a new word today*) is quite probable. We constantly add to our vocabulary. In reading this book, for example, you may learn many new words. The second statement (*I learnt a new sentence today*) is not very likely, since most sentences are not learnt or memorised but rather constructed freely. Some sentences, such as idioms, slogans or sentences from a foreign language, may be learnt as whole entities.

6 *Alex, the African grey parrot.* Answers will vary. Students may point out that Alex's ability to mimic human speech and the size of his vocabulary are quite impressive. They may further point out, however, that the ability to make human-like sounds and to memorise even a large number of words is not, in itself, language. The real question is not whether Alex can use human-like sounds to communicate, which he clearly can, but whether he has human language-like capabilities. Human language is an infinitely creative system made up of discrete, meaningful parts that may be combined in various ways. While Alex's talents are impressive, he can communicate only a small set of messages, while human language is infinitely creative in both the number and kinds of messages transmitted. There is no data demonstrating that Alex has any understanding or use of syntax. Without syntax, the communication system cannot be anything more than a communication system.

7 Communication system of a wolf.

While a wolf's communication system is quite large and complex, it is finite and restricted to a limited set of messages within a single domain (the wolf's current emotions). Human language, on the other hand, is capable of expressing an infinite number of messages on any topic. Moreover, a wolf is unable to produce new messages using a different combination of independently meaningful gestures the way humans can.

8 A dog's understanding of speech.

No. Even if the dog learned to respond to given cues to heel, sit up, beg, roll over, play dead, stay, jump and bark in the correct way, it would not be learning language since its response would be driven solely by those cues. Such responses

are stimulus-controlled behaviour. There is no creative aspect to the system; the dog could not associate a novel combination of cues with a complex action.

9 'Correct' rules of grammar.

Here are some rules, often taught in English classes, which seem unnatural to many speakers:

- a** Never end a sentence with a preposition. Yet *What are you putting those marbles into?* is more common and natural for the majority of English speakers (including teachers of English) than *Into what are you putting those marbles?* English grammar permits the splitting of prepositional phrases.
- b** Don't split infinitives (i.e. don't insert anything between the infinitive marker *to* and the verb). However, a sentence such as *He was the first one to successfully climb Mount Everest* is grammatical.
- c** Use *whom* rather than *who* when the pronoun is the object of a verb or preposition, e.g. *Whom (rather than who) did you meet yesterday?* While this may have been part of the mental grammar of English speakers in the past, for most dialects the syntax has changed and *Who did you meet yesterday?* is the grammatical or 'acceptable' structure.

The essay may point out that a descriptive grammar describes speakers' basic linguistic knowledge while a prescriptive grammar postulates a set of rules that are considered 'correct'. Prescriptive grammarians often misunderstand the nature of language change and ignore the fact that all dialects are rule-governed and capable of expressing thought of any complexity.

- 10** Chomsky believes that if apes were endowed with the ability to acquire language they would do so. The answer to this question should reflect an understanding of the studies presented in the chapter, which purport to show that the acquisition of language follows a pattern of development analogous to other kinds of biological development and is a result of a biological endowment specific to humans. The basis of the remark is in the fact that humans acquire language without instruction, while apes do not. (In fact, apes do not do so even with instruction.) The remark is also based on the assumption that the communication system used by apes is qualitatively different from human language; by 'language ability' Chomsky means 'human language ability'. The analogy to flightless birds implies that learning to speak a language is like learning to fly – it is a property of the species. A species of birds that does not fly simply does not have the biological endowment to do so. An excellent expansion of this answer may be found in some of the works listed the references for Chapter 1, including Anderson 2008 and Bickerton 1990.

11 Song titles.

Answers will vary. Some examples are:

- '(I Can't Get No) Satisfaction' – The Rolling Stones
- 'Gonna Make You Sweat' – C & C Music Factory

- 'We Gotta Get Out Of This Place' – The Animals
- 'Ain't Too Proud To Beg' – The Temptations
- 'The Times They Are A-Changin'' – Bob Dylan

12 Understanding the reality of a person's grammar.

Answers will vary. The essay might be along the following lines:

Linguists who want to understand the reality of a person's grammar can learn a lot by observing which sentences are possible and which are impossible. They would do this by observing the utterances people make, and by deducing, perhaps by asking speakers, what kinds of utterances would not be made. The internal grammar must work so that it can produce all the possible sentences but none of the impossible ones. Linguists can hypothesise possible internal grammars, then see how well they perform at generating only the possible sentences. If the proposed grammar generates impossible sentences, or fails to generate possible ones, then it can be revised. In this way, linguists can develop increasingly sophisticated models of the internal grammars which speakers use. Linguists must take competence and performance into account so they distinguish between sentences like *The very, very, very, very, very, very, very, very, very old man arrived late*, which is possible but non-occurring, and *They swam in the pool*, which may occur as a slip of the tongue but is nonetheless not possible as a well-formed sentence.

13 *My Fair Lady*.

One example is 'The rain in Spain stays mainly in the plain', which is an attempt to get Eliza to pronounce the *a*-sound the way the upper classes pronounce it.

14 Bilingual or multilingual.

Note: Parts (a) and (b) are open-ended.

- a** A student might observe that if the strong version of the Sapir–Whorf hypothesis is true, then a bilingual person might be schizophrenic by having a dual world view forced on her by the two languages she knows.
- b** A student might observe an idiom such as the French *marriage de convenance* that suggests that French speakers take marriage lightly. Students should consider both strong and weak versions of the Sapir–Whorf hypothesis in answering.
- c** Should be 'no'; i.e. you can always translate, even if it means a lot of circumlocution. But there may be connotations, or shades of meaning that are not easy to translate, so translating *le mot juste* from French into 'the right word' doesn't capture the connotation of it being the *perfectly* right word for the occasion.

15 South American indigenous language.

The answer regarding Pirahã will vary. Readings will show that the Pirahã people do have difficulties doing quantitative comparisons with numbers larger than six or eight. However, in their culture there is little need for dealing with quantities in a precisely discrete manner, so it is questionable whether the language is influencing the culture or vice versa. The same is true for colour terms, and the student reader may also learn that there are few if any kinship relation terms. However, in this case as well there may be a cultural explanation in that the people are so heavily intermarried that such terms probably wouldn't make much sense.

16 British English words for woods and woodlands.

a Answers will vary.

b Answers will vary. Students may discuss the meaning differences freely.

The following definitions were found on dictionary.reference.com, except for the one marked with *, which was found on www.merriamwebster.com/dictionary:

bosky: 'covered with bushes, shrubs, and small trees; woody'

bosquet: 'a grove; thicket'

brush: 'a dense growth of bushes, shrubs, etc.; scrub; thicket'

bush: 'a large uncleared area thickly covered with mixed plant growth, trees, etc., as a jungle'

carr: 'fen; low land that is covered wholly or partly with water unless artificially drained and that usually has peaty alkaline soil and characteristic flora (as of sedges and reeds)'

coppice: 'a thicket of small trees or bushes; a small wood'

copse: 'a thicket of small trees or bushes; a small wood'

fen: 'low land covered wholly or partially with water; boggy land; a marsh'

firth: 'a long, narrow indentation of the seacoast'

forest: 'a large tract of land covered with trees and underbrush; woodland'

grove: 'a small wood or forested area, usually with no undergrowth'

heath: 'a tract of open and uncultivated land; wasteland overgrown with shrubs'

holt: 'a wood or grove; a wooded hill'

lea: 'a tract of open ground, esp. grassland; meadow'

moor: 'a tract of open, peaty wasteland, often overgrown with heath, common in high latitudes and altitudes where drainage is poor; heath'

scrub: 'a large area covered with low trees and shrubs'

shaw: 'a small wood or thicket'

spinney: 'a small wood or thicket'

stand: 'the growing trees, or those of a particular species or grade, in a given area'

thicket: 'a thick or dense growth of shrubs, bushes, or small trees; a thick coppice'

timberland: 'land covered with timber-producing forests'

weald: 'wooded or uncultivated country'

wold: 'an elevated tract of open country'

woodlot: 'a tract, esp. on a farm, set aside for trees'

- c Answers will vary. An answer supporting the idea that English speakers have a richer concept of woodlands than speakers whose language has fewer words might argue that the plethora of words itself is evidence that the speakers have a rich concept of woodlands. An argument against this might say that a speaker's concept of woodlands probably had more to do with that speaker's personal experience with different types of woodlands, perhaps due to the geography of the area in which he lives, and less to the words available to describe those woodlands in his language. Following this argument, if a group of speakers of a language without many words for woodlands moved to a new area and were suddenly experiencing different types of woodlands on a daily basis and needing to distinguish between the varying types, these people would probably create new words in their language to fill that need, or perhaps "borrow" needed words from an indigenous language.

17 English *dge* words.

Answers will vary. A sample list of *dge* words follows:

Neutral: *edge, wedge, sledge, pledge, budge, fudge* and *smidgeon*.

Unfavourable: *curmudgeon, sludge, hodge-podge* and *smudge*.

Students should discuss the meaning of *budget*. One possible observation is that *budget* is not necessarily unfavourable, although it does consist of limits. For example, if I had a budget of \$10 000 for my birthday party, I would find nothing unfavourable about that. Other potentially neutral *dge* words also include limits, like *edge*. Others could potentially have an unfavourable connotation, like *wedge*, *sledge* and *budge*, which suggest a certain amount of force. But again, depending on the situation, that may be favourable or unfavourable. For example, *I really wanted to get the book out from under the car's tire but it wouldn't budge* seems negative, but *I've decided to give you \$100 and my mind is made up; I won't budge* could be positive.

18 Euphemisms.

Answers will vary. Below are three possible examples:

toilet → bathroom → restroom

arse → butt → bottom/backside

negro → black → African American

19 *Cratylus Dialogue.*

Answers will vary. Those that find that Socrates' point of view was sufficiently well argued to support the thesis that the relationship between form and meaning is indeed arbitrary might point out Hermogenes' argument that "in different cities and countries there are different names for the same things; Hellenes differ from barbarians in their use of names, and the several Hellenic tribes from one another." In other words, we can say that objects in the world are called different things in different languages and sometimes even in different dialects of the same language.

On the other hand, answers that find that Socrates' point of view was not sufficiently well argued to support the thesis of arbitrariness might point out his summary of Protagoras' argument that "things are not relative to individuals, and all things do not equally belong to all at the same moment and always, they must be supposed to have their own proper and permanent essence: they are not in relation to us, or influenced by us, fluctuating according to our fancy, but they are independent, and maintain to their own essence the relation prescribed by nature." Put another way, this argument says that each item in the world has its own essence, and presumable name, independently of whether humans speaking any particular language call it by that name or not.

20 Pirahã.

Answers will vary, but the main principles in question are that according to the linguist Daniel Everett, Pirahã doesn't have recursion, which Chomsky predicts is a universal of all languages. Everett also claims that Pirahã lacks words for numbers and has no fixed color terms. Students should discuss the persuasiveness of the argument.

21 Answers will vary. Those who argue that the lexicon of English should be counted as all the words in English, past and present, may point out that even if a word is no longer in use, it could be brought into use again if it were needed. Furthermore, although the word is no longer used, it still is an English word that has fallen into disuse, and not, e.g., a French word. Thus, it should be counted as part of the English lexicon. Those who argue instead that the lexicon of English should only be counted as the words currently in use may point out that it would be absurd to count words that are no longer used by any English speaker as part of the English lexicon, and if this faulty methodology were taken to its extreme we may count words from Proto-Indo-European as belonging to the English lexicon! Obviously, that would be ridiculous, but the line must be drawn somewhere. One logical place to draw that line could be that only those words currently used by any native speaker of English should be counted as being part of the (current) English lexicon.

Chapter 2

Brain and language

1 Lateralisation.

Answers will vary. A student's essay might include some of the following:
Possible arguments for Sperry's position:

- Studies on split-brain patients demonstrate differentiation of functions of the right and the left hemispheres.
- Damage to the right hemisphere may result in non-linguistic cognitive deficits with language remaining largely intact. Conversely, left hemisphere damage frequently results in aphasia without necessarily affecting other cognitive functions. This argues for separate minds with separate functions.

Possible arguments for Eccles' position:

- Eccles must believe that thought cannot be expressed without language. If this is so, since only the left hemisphere is specialised for language, it can be argued that the right hemisphere cannot think.
- The left hemisphere is not only specialised for language, but also for mathematical and some other cognitive abilities which are purely human.

There is, however, growing evidence that the physical brain and the mind that results from its neural architecture and functions are highly complex on both sides, that distinct cognitive systems are represented and processed in different locations and that these interact in mental behaviour. Furthermore, thinking does not require language, as shown by split-brain patients and by humans who never acquire language but who are functionally capable in other cognitive spheres. Deaf individuals, for example, who have not been exposed to sign language are still capable of learning and thinking.

2 How words are stored in the brain.

a i. The substituted words in this group are in the same syntactic category as the stimulus words and are semantically related. They are not phonologically similar.

ii. The substituted words in this group are, for the most part, derivationally related to the stimulus words which are verbs. In the case where the substituted word is not directly derived from the stimulus word (speak/discussion), it is still semantically related to it.

b The words in these two groups show that words are connected to each other according to semantic class and syntactic category.

3 Aphasic language. Answers will vary.

Sample answers:

a There is under a horse a new sidesaddle.

In non-aphasic language, the prepositional phrase (*under a horse*) follows the noun phrase (*a new sidesaddle*) in sentences of this form. Also, in normal speech, the preposition would be *on* rather than *under*. It is also likely that the article would be *the*, not *a*. If *horse* is not definite, the usual expression would be *there is a new sidesaddle on one of the horses*.

b In girls we see many happy days.

This sentence is grammatically well-formed but it is not easily interpreted. Metaphorical speech and aphasic speech share some common ground.

c I'll challenge a new bike.

In non-aphasic language, the verb *challenge* generally, but not always, takes a human or abstract noun (e.g. *challenge the judge/law*). Here, the verb is followed by an inanimate, concrete object, which is unusual. The intended meaning is unclear without further context.

d I surprise no new glamour.

The verb *surprise* must take an animate object (e.g. *surprise a friend*). Here, the verb is followed by an inanimate, abstract object. The intended meaning is unclear and the sentence is uninterpretable.

e Is there three chairs in this room?

The verb *is* – the singular form of the verb *be* – should be in the plural form *are* to agree in number with the subject of the sentence (*three chairs*).

f Mike and Peter is happy.

The verb should agree with the number of the subject noun phrase which, in this case, is plural (*Mike and Peter*). The verb should therefore be *are*.

g Bill and John likes hot dogs.

Same as item f. The verb *likes* is singular but the subject is plural.

h Proliferate is a complete time about a word that is correct.

In non-aphasic language, *proliferate* is a verb and cannot be used as the subject of a sentence. The sentence is uninterpretable.

i Went came in better than it did before.

In non-aphasic language, a past tense verb form such as *went* cannot be used as the subject of a sentence. It is not clear what the intended meaning of the sentence is.

4 Brain damage and neural basis of language.

It is possible to investigate different functions of a complex automobile engine by systematically damaging individual parts to see what the effect might be. This is also true of brain research; lesions in different parts of the brain result in specific linguistic or other cognitive deficits. Syntax can be impaired with semantics and phonology retained and vice versa. Engines are like brains in that they can limp along without all cylinders firing, with an impeded fuel flow, with short circuits, with computer components such as oxygen sensors failing, etc.

Individual answers to the question will vary but if the question is assigned by instructors, students should be encouraged to consult the literature to show the kinds of deficits which can occur due to damage to different brain sites.

5 Evidence for lateralisation.

Sample answers:

- Brain damage research provides strong evidence for lateralisation of brain functions. Right and left hemispheric damage each affect functioning of different cognitive systems.
- Studies of childhood brain lesions suggest that the human brain is lateralised to the left for language from birth.
- Research on individuals with split brains offers further evidence for language lateralisation.
- Results of dichotic listening research support lateralisation of brain functions.
- MRI and PET studies demonstrate that the two hemispheres perform different cognitive functions.

6 Discussion of Wigan's comment.

Individual answers will vary. The answer may include a discussion of the different cognitive functions that the two hemispheres perform.

7 Dichotic listening.

Some possible visual stimuli for dichotic listening experiments:

- Printed words to read. (We would expect to get fewer errors when reporting stimuli presented in the right visual field.)
- Pictures of objects to copy. (Fewer errors for the stimuli in the left field expected.)
- Pictures of faces expressing different emotional states, e.g. happy/sad faces, etc. Subjects would be asked to say what the emotion is. (Fewer errors in the left field expected.)
- Printed strings of letters, some of which are words, and some non-words.
- Subjects' task is to say whether the string is a word. (Fewer errors expected in the right visual field.)

8 Utterances of Broca's and Wernicke's aphasics.

a W

b B

c W

d B

9 *Hamlet*.

Possible arguments that Hamlet was a Wernicke's aphasic:

- His speech here makes little sense.
- He uses some very odd expressions, such as '... eyes purging thick amber and plum-tree gum'.

Possible arguments against this position:

- There are no neologisms.

- Although very difficult to interpret, his sentences are almost entirely grammatical.
- 10** Simultaneous stimuli.
This would suggest dominance of the left hemisphere for language.
- 11** Bilinguals and aphasia.
This would suggest that the left hemisphere is less dominant for language in bilinguals than it is in (most) monolingual speakers.

12 Mini-research projects:

a Perfect pitch.

Answers will vary. A student's answer should include a definition of 'perfect pitch' and an explanation of how this relates to the critical age hypothesis. An answer might include some of the following:

Definition of perfect pitch

- The ability to recognise the pitch of a musical tone without an external reference pitch.

Relation to critical-age hypothesis

- As with language, the ability to distinguish perfect pitch needs to be exercised at a young age or it will go away by adulthood.
- The critical-age hypothesis states that the ability to learn a grammar develops within a fixed period, from birth to middle childhood, as long as there is linguistic input. In cases where children are denied linguistic input, they never master the grammar with native proficiency. The same is true of perfect pitch. If a child has limited exposure to musical input, s/he will be less likely to develop perfect pitch.

b Brain imaging technologies.

Answers will vary. The sample answer below is based on information found at www.radiologyinfo.org, www.mayfieldclinic.com and <http://www.nmr.mgh.harvard.edu/research/imaging-technologies>. A student's answer should consider several of the methodologies listed below, comparing and contrasting their upsides and downsides freely:

CT (computer tomography) scan

Upsides: painless, non-invasive, and accurate; provides very detailed images; fast and simple; cost-effective; less sensitive to patient movement than MRI; provides real-time imaging; no radiation remains in a patient's body after a CT examination; X-rays used in CT scans usually have no side effects.

Downsides: a slight chance of cancer from excessive exposure to radiation; possibility of serious allergic reaction to contrast materials (extremely rare); CT scans are not recommended for pregnant women or children because of the exposure to radiation; nursing mothers should wait 24 hours after scan before resuming breastfeeding.

PET (positron emission tomography) scan

Upsides: the information provided is unique and often unattainable using other imaging procedures; cost effective and precise; identifies changes in the body at the cellular level.

Downsides: low radiation exposure, but no known long-term adverse effects from such low-dose exposure; possibility of allergic reactions to radiopharmaceuticals (extremely rare and usually mild); injection of the radiotracer may cause slight pain and redness.

MRI (magnetic resonance imaging) scan

Upsides: non-invasive, with no exposure to ionising radiation; allergic reaction to contrast material less likely than that used for CT; almost no risk when appropriate safety guidelines are followed.

Downsides: if sedation is used there are risks of excessive sedation; implanted medical devices that contain metal may malfunction due to the strong magnetic field; possibility of nephrogenic systemic fibrosis, a rare complication believed to be caused by the injection of high doses of MRI contrast material in patients with very poor kidney function.

fMRI (functional MRI) scan

Upsides: non-invasive; no exposure to ionising radiation; can assess both structure and function of brain; almost no risk to the average patient when appropriate safety guidelines are followed.

Downsides: same as for MRI.

SPECT (single photon emission CT) scans

Upsides: can view blood flow through arteries and veins in the brain; different from either MRI or CT scanning because it can detect reduced blood flow to certain sites.

Downsides: small risk from exposure to radiation, which is less than received during a chest X-ray or CT scan; not safe for women who are pregnant or nursing.

MEG (magnetoencephalography)

Upsides: completely non-invasive and non-hazardous; localises and characterises the electrical activity of the central nervous system by measuring the associated magnetic fields emanating from the brain; the data can be collected in a seated position, allowing more lifelike experiments than fMRI; the measurement environment is completely silent, which allows for auditory studies; electrodes do not need to be pasted to the scalp as with EEG.

Downsides: the localisation of sources of electrical activity within the brain from magnetic measurement outside the head is complicated; it is difficult to obtain reliable information about subcortical sources of brain activity; does not provide structural/anatomical information; the measurements have to be taken in a magnetically shielded room.