Language and the brain

PSY 200

Greg Francis

Lecture 31

What's the big deal about Nim Chimpsky?

Purdue University

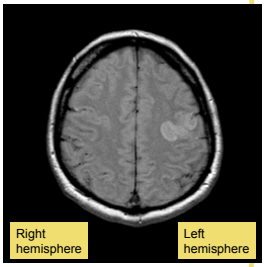
Language

- Properties
  - grammar
  - phrases
  - words
- Instinct
  - different from other types of learning
  - special areas in the brain related to language
  - evolution: can similar brains learn language?

Purdue University

Broca's aphasia

- Some stroke patients show agrammatical speech
- Seem to know what they want to say
  - But are unable to say it



Purdue University

Broca's aphasia

- Some stroke patients show agrammatical speech
  - repetition
  - short sentences
  - true for both written and spoken
  - no problem controlling mouth
    - » e.g. blowing out candles

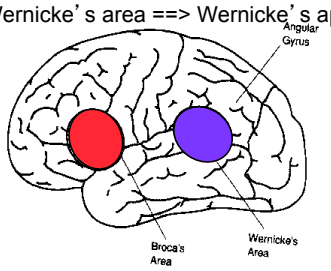
Do you drive home on weekends?

Why, yes…Thursday, er, er, er, no, er Friday…Barba-ra…wife …and, oh, car…drive… purnpike…you know… reset and…teevee.

Purdue University

Brain damage

- Broca's area ==> Broca's aphasia
- Wernicke's area ==> Wernicke's aphasia



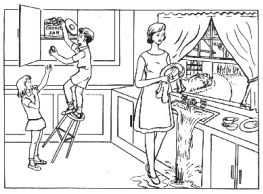
Broca's aphasia

- Mr. Ford
  - omitted endings (-ed, -s)
  - omitted function words (or, be, the)
  - skipped function words when reading (or, be, the) but read similar sounding words (oar, bee)
  - named objects and recognized names
  - high (nonverbal) IQ

Purdue University

Broca's aphasia

- Difficulty getting ideas across
- Patient BL was asked to describe this picture



B.L.: Wife is dry dishes. Water down! Oh boy! Okay Awright. Okay ...Cookie is down...fall, and girl, okay, girl...boy...um...
Examiner: What is the boy doing?
B.L.:Cookie is...um...catch
Examiner: Who is getting the cookies?
B.L.: Girl, girl
Examiner: Who is about to fall down?
B.L.: Boy...fall down!

Purdue University

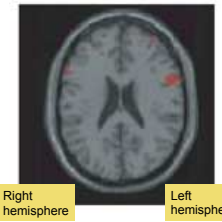
Broca's aphasia

- Could understand questions if gist could be deduced from content words
  - Do you use a hammer for cutting?
  - Does a stone float on water?
- Failed to understand anything requiring grammatical analysis
  - The lion was killed by the tiger, which one is dead?

Purdue University

Broca's area

- Plays a role in learning the rules of a language
- Musso et al. (2003)
  - fMRI while subjects judge whether Italian sentences are grammatically correct or not
  - At start, subjects did not know rules of Italian
  - Broca's area is activated
  - Signal correlates with correct identification



Purdue University

Wernicke's aphasia

- Other stroke patients also show agrammatical speech
- Seem to be able to say things
  - But what they say is almost meaningless

Purdue University

Wernicke's aphasia

- Patients show
  - poor comprehension
  - poor vocabulary
  - "empty" speech

What brings you to the hospital?

Boy, I'm sweating, I'm awful nervous, you know, once in a while I get caught up, I can't mention the tarripoi, a month ago, quite a little, I've done a lot well. I impose a lot, while on the other hand, you know what I mean, I have to run around, look it over, trebbin and all that sort of stuff...

Purdue University

Wernicke's aphasia

- Difficulty getting ideas across

H.W.:First of all this is falling down, just about, and is gonna fall down and they're both getting something to eat...but the trouble is this is gonna let go and they're both gonna fall down...but already then...I can't see well enough but I believe that either she or will have some food that's not good for you and she's to get some for her too...and that you get it and you shouldn't get it there because they shouldn't go up there and get it unless you tell them that they could have it. and so this is falling down and for sure there's one they're going to have for food and, and didn't come out right, the uh, the stuff that's uh, good for, it's not good for you but it, but you love it, um mum mum (smacks lips)...and that so they've...see that, I can't see whether it's in there or not.

Examiner:Yes, that's not real clear. What do you think she's doing?

H.W.:But, oh, I know. She's waiting for this!

Examiner:No, I meant right here with her hand, right where you can't figure out what she's doing with that hand.

H.W.:Oh, I think she's saying I want two or three, I want one, I think, I think so, and so, so she's gonna get this one for sure it's gonna fall down there or whatever, she's gonna get that one and, and there, he's gonna get one himself or more, it all depends with this when they fall down...and when it falls down there's no problem, all they got to do is fix it and go right back up and get some more.

Purdue University

Wernicke's aphasia

- Most aphasias involve damage to more than just one specific area

Anomia

- Damage *around* Wernicke's area produces a deficit in the ability to *name* things
  - e.g., after a stroke in this area CB cannot retrieve *nouns* he wants to use

C.B. Uh, well this is the...the...of this. This and this and this and this. These things going in there like that. This is...things here. This one here, these two things here. And the other one here, back in this one, this one...look at this one.

Examiner Yeah, what's happening there?

C.B. I can't tell you what that is, but I know what it is, but I don't know where it is. But I don't know what's under. I know it's you couldn't say it's ... I couldn't say what it is. I couldn't say what that is. This shu-- that should be right in here. That's very bad in there. Anyway, this one here, and that, and that's it. This is the getting in here and that's the getting around here, and that, and that's it. This is getting in here and that's the getting around here, this one and one with this one. And this one, and that's it, isn't it? I don't know what else you'd want.

Purdue University

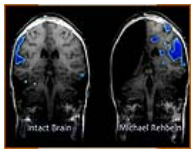
Anomia

- Sometimes anomia can be remarkable specific
- Some patients have difficulty with only certain types of nouns
  - concrete vs abstract (chair vs trust)
  - nonliving vs living (table vs dog)
  - animals and vegetables vs food and body parts
  - colors
  - proper names

Purdue University

Brain and language

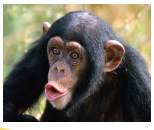
- Recall that the left side of the brain is more involved in language than the right side
  - Broca's and Wernicke's areas are on the left hemisphere
- However, the right hemisphere can also work with language
  - left handed people
  - hemispherectomies (age matters!)



Purdue University

Brain and evolution

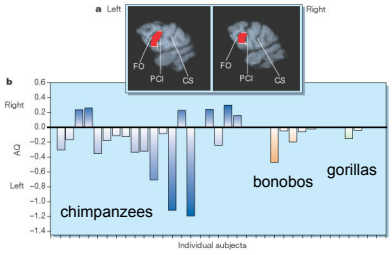
- We've argued that language is an evolved instinct
  - differences in brains account for differences in abilities
- One might hope to find proto-language abilities in "close" animals to humans
  - Chimpanzees, apes
- Anatomically, there are many similarities between human brains and apes and chimpanzees



Purdue University

Brain and evolution

- Cantalupo & Hopkins (2001)
  - Broadmann's area 44 (part of Broca's area in humans)
  - Compare area on left and right hemispheres
    - » Larger on left for humans and apes



Implies hemisphere asymmetries that underlay language began at least 5 million years ago

Chimpanzee language

- In the 1960s several research groups reported teaching chimpanzees American Sign Language (ASL)
  - after failure to teach spoken language
  - other groups taught chimps to press symbols on a computer keyboard or string magnetized plastic shapes on a board
- Claimed to teach chimps hundreds of words
  - and chimps created new compound words
    - » swan -> water bird
    - » stale Danish -> cookie rock
    - » See video: http://www.npr.org/templates/story/story.php?storyId=90516132

Purdue University

Problems

- Just like with Eliza (the computer therapist) it is easy to attribute language ability where it does not really exist (9 month old children)
- You can teach an animal a lot using simple conditioning tricks
- Researchers were quick to excuse mistakes as "play", "jokes", "puns", "metaphors",...

Purdue University

Word counts

- For example, a deaf student on one research team later commented that she saw much fewer signs than the non-deaf students
  - seems the researchers counted almost *any* hand movement as a sign
- Like
  - scratch --> "scratch"
  - pointing --> "you"
  - finger to mouth --> "drink"
  - hugging --> "hug"
  - reaching --> "give"
  - kissing --> "kiss"

Purdue University

Nim Chimpsky

- A relative of other "signing" chimps
  - with more careful judging probably learned approximately 25 words
  - moreover, the "signs" were variations of the natural movements of chimps in the wild
- The chimps did *not* learn ASL

Purdue University

Grammar

- Chimps failed to learn the rules of ASL grammar
  - unable to understand complex signs
- Seemingly able to understand complex sentences
  - Would you please carry the cooler to Penny?
- But really, the chimp need only understand two words: cooler and Penney
  - the rest can be guessed!

Purdue University

Grammar

- Likewise, the chimps never produced complex sentences
- They tended to "say" things like the following
  - Nim eat Nim eat.
  - Drink eat me Nim.
  - Tickle me Nim play.
  - Me eat me eat.
  - Me banana you banana me you give.
  - Banana me me me eat.
  - Give orange me give eat orange me eat orange give me eat orange give me you.

they *communicate* but not with real language

Purdue University

Evolution

- Note, it would have been interesting if chimps could learn language
  - and not inconsistent with the idea that we have a language instinct
- But the failure of chimps to learn language does not go against the idea that language evolved in humans
  - as some people have proposed

Purdue University

Evolution

- Chimps *are* the closest evolutionary relatives of humans
  - so if any non-human animal could learn language it would probably be chimps
- But in evolutionary history, chimps and humans split from a common ancestor millions of years ago
- Humans evolved a language skill and chimps did not

Purdue University

Conclusions

- Language and the brain
- Broca's aphasia
- Wernicke's aphasia
- Anomia
- Chimps

Purdue University

Next time

- Consciousness
- Dualism
- Artificial intelligence
- Qualia

- *Do you see red like I see green?*

Purdue University