LSci51/Psych56L: Acquisition of Language

Lecture 22

Language in special populations I

Announcements

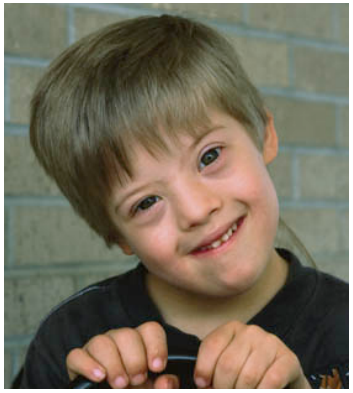
Review questions available for language development in special populations

HW6 due 12/11/20

Please fill out course evaluations

Remember that extra credit is available!

Consider taking more language science classes (LSci)!



Special populations

Why special populations?

Not everyone is a typically-developing child.

We can explore how different human abilities contribute to the human language acquisition process.

Does language develop differently if there's no visual input (blind children)?

Does language develop differently if there's no auditory input (deaf children)?

Blind children

Why blind children?

Blind children hear and talk, but lack visual cues to language:

Ex 1: achieving joint attention through pointing and eye gaze isn't possible.

Why blind children?

Blind children hear and talk, but lack visual cues to language:

Ex 2: visual information about lip configurations for producing sounds isn't available.

Linguistic development of blind children

Phonological development: Blind children make more errors than sighted children with sounds that involve visible articulatory movements (/b/, /m/, /f/).

Linguistic development of blind children

Lexicon development: Blind children have fewer words for things that can be seen, but not touched (like *flag*, *moon*). They have more words for things associated with auditory change.

Notably, Bedny, Koster-Hale, Elli, Yazzolino, & Saxe (2019) show that blind individuals have detailed knowledge of visual perception verbs like *peek, stare, blaze, glow,* and *flash* — just as detailed as sighted individuals do.

Linguistic development of blind children

Syntactic development: Same as that of sighted children.

- Some differences due to mother's input (fewer questions, more commands), which leads to late auxiliary verb (*has*, *is*) acquisition

Insight into first language acquisition

One perspective: language development builds on nonverbal communication, and on accessing the meanings of sentences from the observable nonlinguistic context.

But blind children can't do either of these - yet they still acquire language the same way (and at the same time) as sighted children do.

Implication: Nonlinguistic cues are helpful, but not necessary. Syntactic information in the language itself can be just as useful. (Remember how useful syntactic bootstrapping was for lexical acquisition.)

Deaf children

Signed language

Signed languages, which are a main way that deaf individuals communicate, are just as complex as spoken languages - it's just that they're expressed with manual gestures and facial expressions, rather than spoken words.

Sign language sample:
http://www.youtube.com/watch?v=K3PlAbBbHSU&feature=player_embedded

Signed language

Berent, Bat-El, Brentari, Dupuis, & Vaknin-Nusbaum 2017:

"…linguistic principles are amodal and abstract"

https://www.sciencedaily.com/releases/2016/11/161108100759.htm

"Currently there is a debate as to what role sign language has played in language evolution, and whether the structure of sign language shares similarities with spoken language. Berent's lab shows that our brain detects some deep similarities between speech and sign language."

Signed language in brains

Brookshire, Lu, Nusbaum, Goldin-Meadow, & Casasanto 2017:

https://www.sciencedaily.com/releases/2017/06/170608145521.htm

"Language is one of those areas in which scientists observe neural entrainment: When people listen to speech, their brain waves lock up with the volume-based rhythms they hear…The study reveals that the brain entrains depending on the information in the signal -- not on the differences between seeing and hearing. Participants' brain waves locked into the specific frequencies of sign language…"

Signed language in brains

Blanco-Elorrieta, Kastner, Emmorey, & Pylkkänen 2018:

https://www.sciencedaily.com/releases/2018/04/180403085042.htm

"…despite obvious physical differences in how signed and spoken languages are produced and comprehended, the neural timing and localization of the planning of phrases is comparable between American Sign Language and English…evidence of overlapping computations at this level of detail is still a striking demonstration of the fundamental core of human language."

Signed language

[Extra]

Signed vs. spoken languages:
http://www.youtube.com/watch?v=p_AAttEQj88
(~6 minutes)
(0:37 - 4:12)
Using signed language to identify what the core properties of any language system are

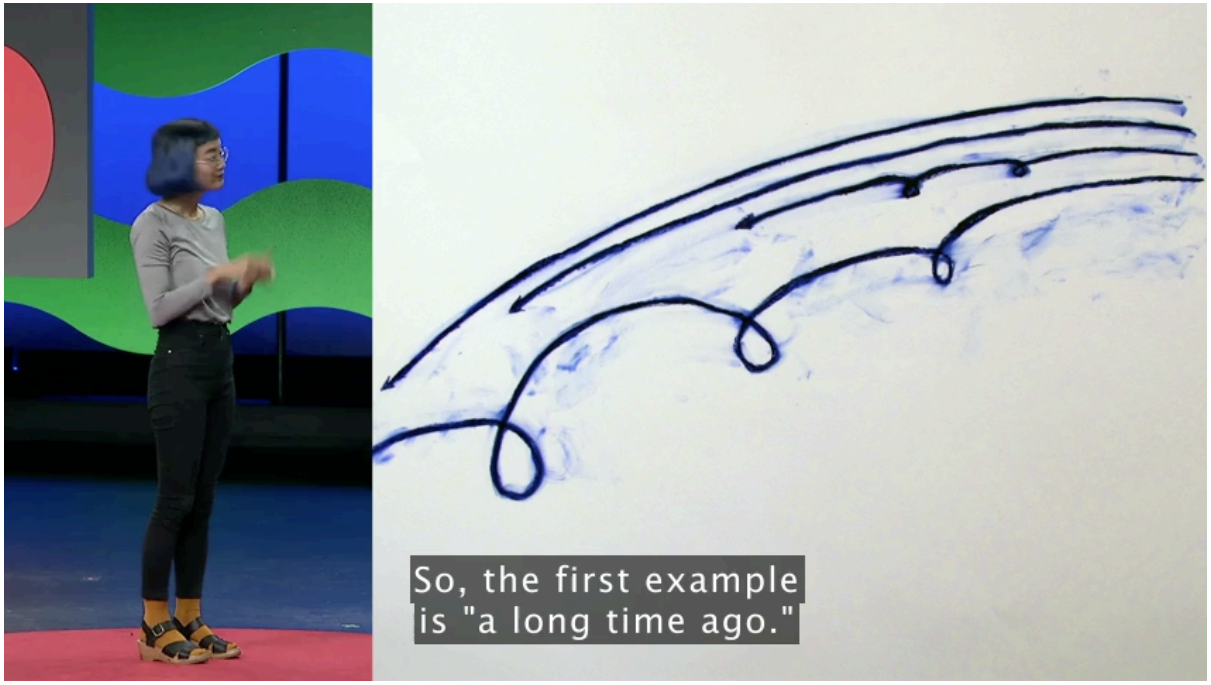
(4:12 - end) [Extra]
Language processing in brains of deaf people (left hemisphere specialization)

Signed language

Lillo-Martin & Gajewski 2014:
“In large part, the linguistic analysis of sign languages has led to the conclusion that universal characteristics of language can be stated at an abstract enough level to include languages in both spoken and signed modalities. For example, languages in both modalities display hierarchical structure at sub-lexical and phrasal level, and recursive rule application. However, this does not mean that modality-based differences between signed and spoken languages are trivial.”

Signed language

Signed languages like ASL do have some iconicity, where the signs resemble the concepts they represent. This can be particularly useful for conveying additional information about those concepts (Schlenker 2018, https://www.sciencedaily.com/releases/2018/11/181106104221.htm).

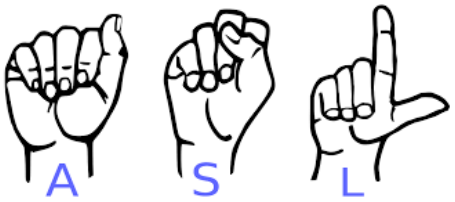


https://www.ted.com/talks/christine_sun_kim_the_enchanting_music_of_sign_language
11:12-11:51

Signed language

A difference in attention, from MacDonald, Marchman, Fernald, & Frank 2018:

Signed language learners (like those learning ASL) have to divide their attention during language comprehension between the language signal (the ASL) coming in and the potential referents that the signer might be referring to (like the nearby penguins the ASL signer is signing about).

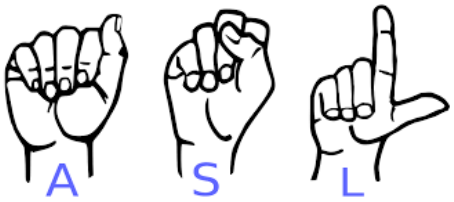


Spoken language learners (like those learning English) don't have to do this as much — they can listen to the language signal while looking at potential referents.

Signed language

A difference in attention to useful visual cues, from Brooks, Singleton, & Meltzoff 2019:

Signed language learners (like those learning ASL) are better attuned than spoken language learners to a parent's eye gaze, a powerful social cue for identifying the the potential referents that the signer might be referring to (like the nearby penguins the ASL signer is signing about).



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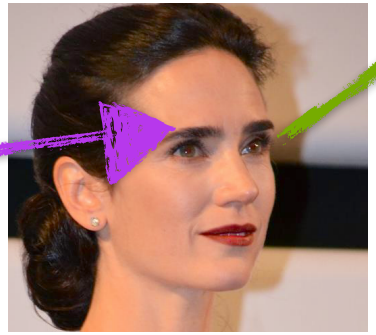


Some American Sign Language (ASL) signs

[Extra]

ASL literature projects:
http://csdr-cde.ca.gov/category/asl-videos/

ASL dictionary:
http://www.aslpro.com

ASL lessons and a dictionary:
http://www.lifeprint.com

ASL dictionary:
https://www.signingsavvy.com

Signing Savvy
YOUR SIGN LANGUAGE RESOURCE

Sign language features

Like spoken language sounds, sign language signs can be broken into features which can be combined:

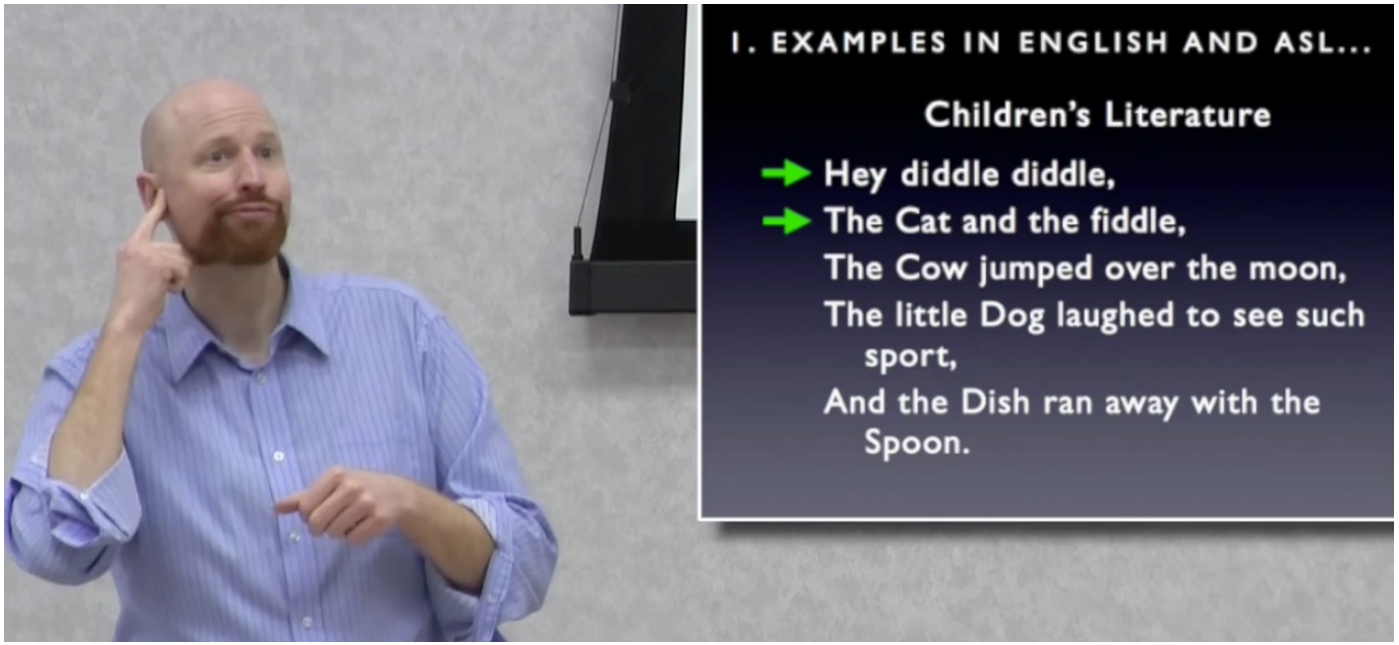
- handshape
- palm orientation (direction palm is facing)
- location
- motion

Notably, features in spoken languages combine to form individual sounds (ex: +stop, +voice, +velar = /g/). Features in signed languages combine to form the equivalent of words.

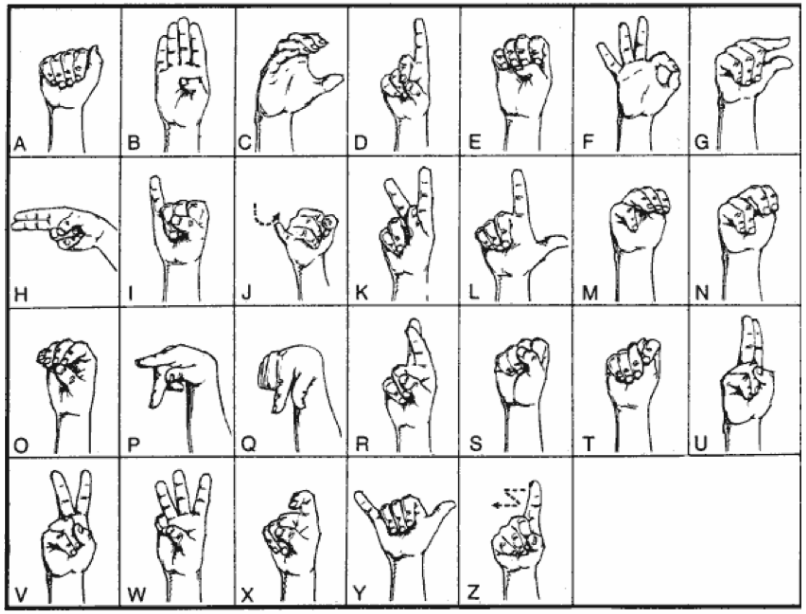
Sign language features make up words

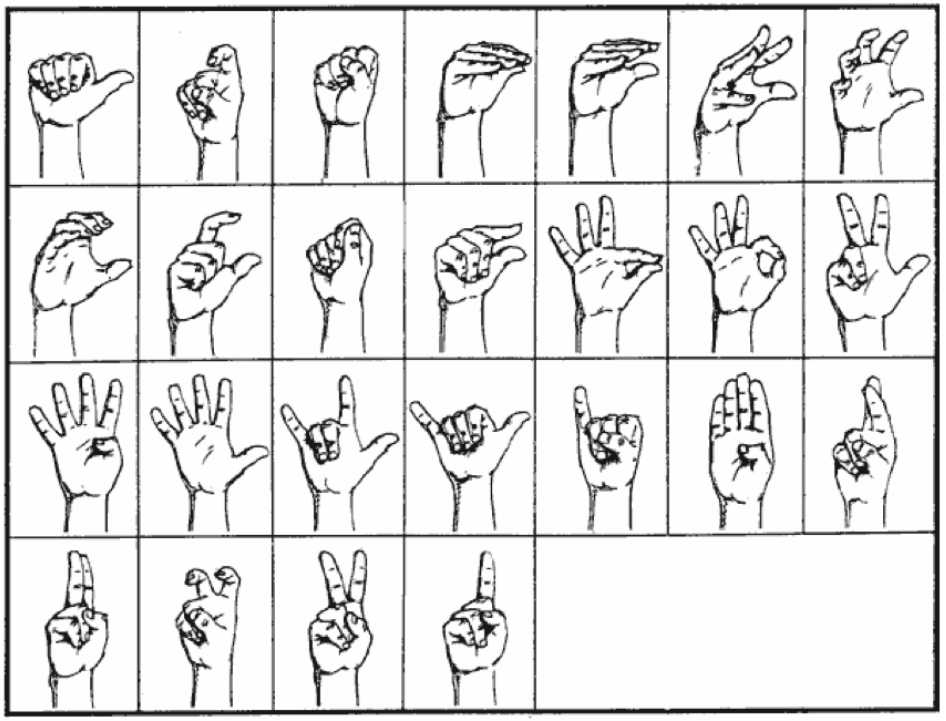
https://www.youtube.com/watch?v=rIoFpxAo93U
0:14 - 3:55

Rhyming in ASL requires breaking the words into their features and playing with those features the way hearing languages break up the sounds of words and play with the sounds



Some ASL handshapes





ASL signs differing only by handshape

https://www.handspeak.com/word/search/index.php?id=1046

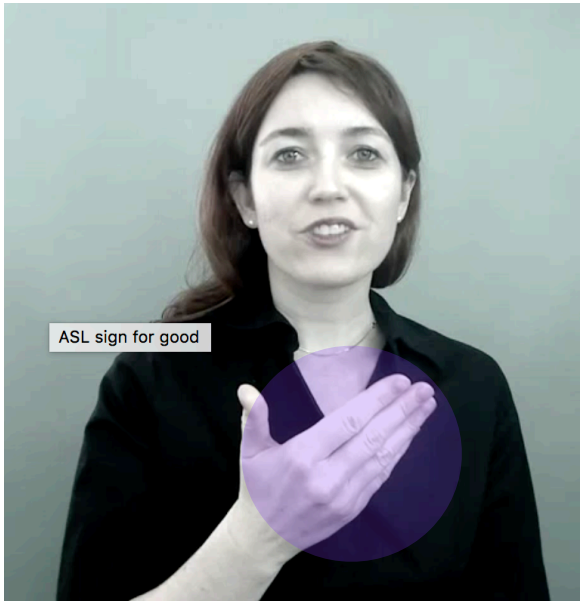
https://www.handspeak.com/word/search/index.php?id=2444

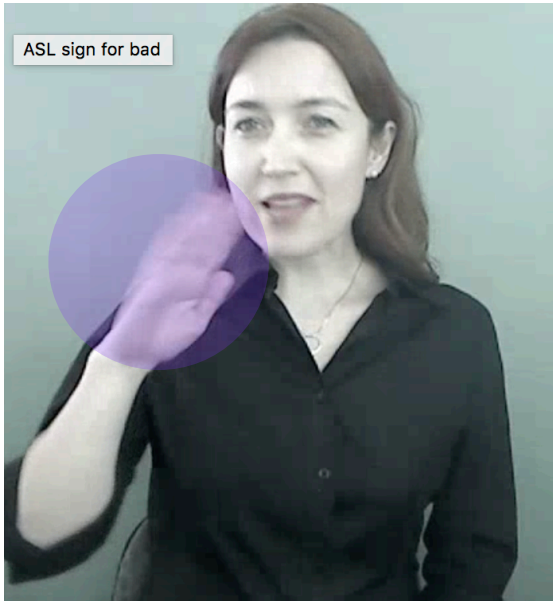
Ex: HOME vs. YESTERDAY

ASL signs differing only by palm orientation

https://www.handspeak.com/word/search/index.php?id=926

https://www.handspeak.com/word/search/index.php?id=150



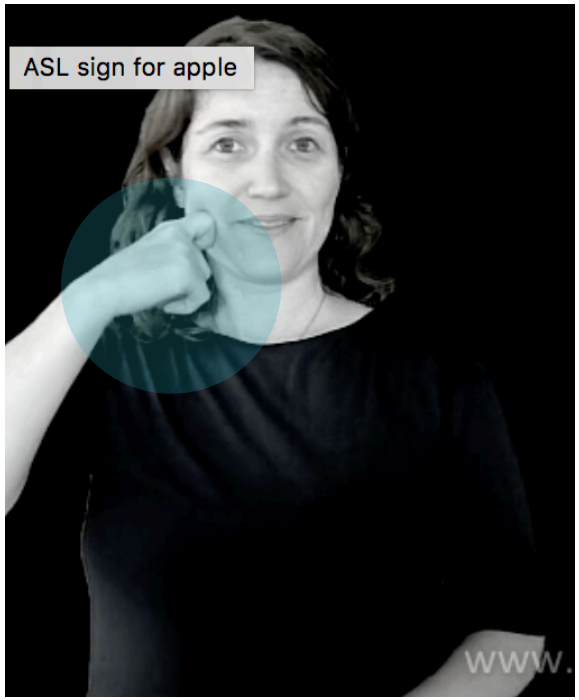


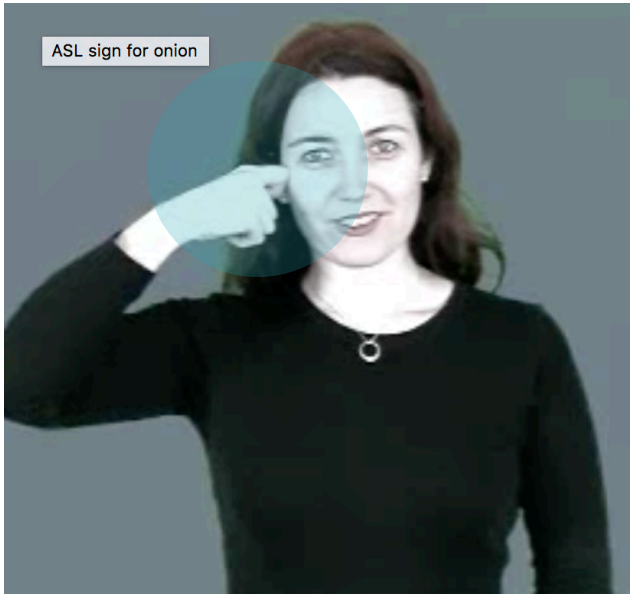
Ex: GOOD vs. BAD

ASL signs differing only by location

https://www.handspeak.com/word/search/index.php?id=97

https://www.handspeak.com/word/search/index.php?id=1559



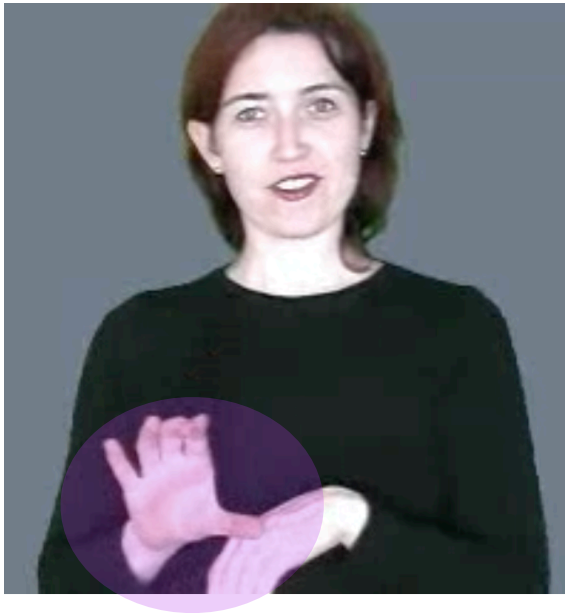


Ex: APPLE vs. ONION

ASL signs differing only by motion

https://www.handspeak.com/word/search/index.php?id=386

https://www.handspeak.com/word/search/index.php?id=393



Ex: CHOCOLATE vs. CHURCH

ASL motion types (and sub-types)

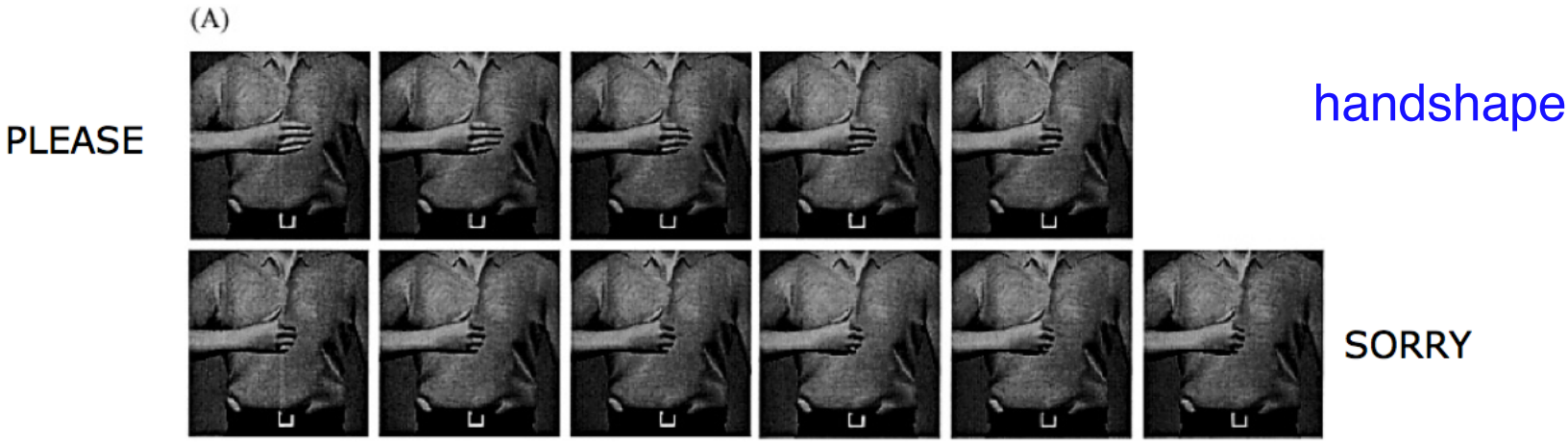
[Extra]

Linear: Up, down, in, out, and to the two sides (contralateral and ipsilateral)

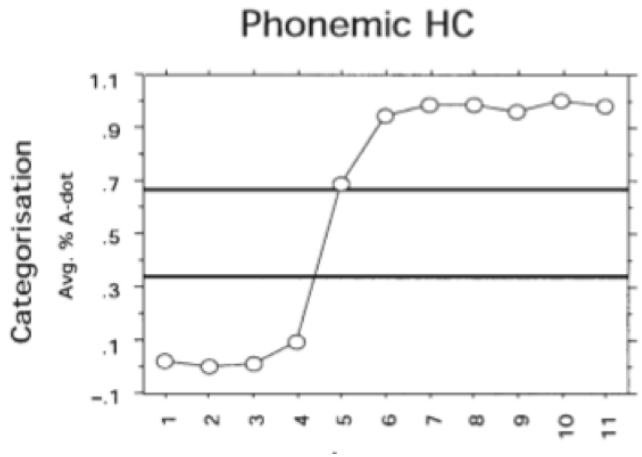
Internal: Opening the hand, closing the hand, bending at the wrist, twisting at the wrist, wiggling the fingers.

Complex: Moving toward a location, moving away from a location, touching a location, brushing a location, crossing (hands or fingers), exchanging hands, grabbing, inserting, and circular motions.

Signers have categorical perception of features



(Emmorey, McCullough, Brentari 2003)



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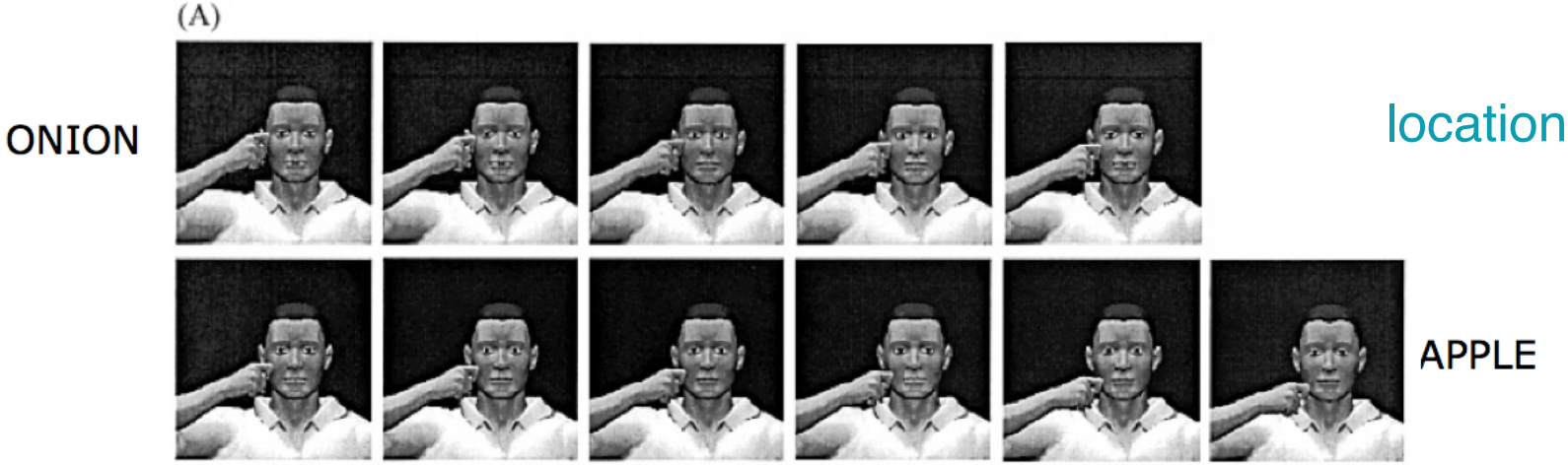
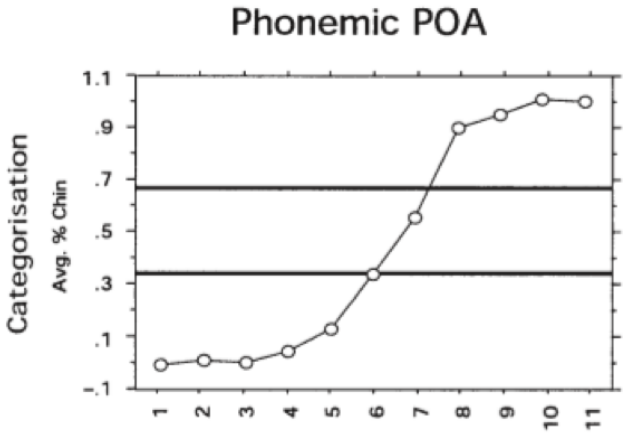


(Emmorey, McCullough, Brentari 2003)



Sign language properties

Sign languages allow for simultaneous articulation of information that spoken languages typically don't.

Example: Aspect + primary sign

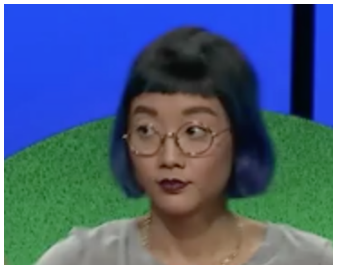
Repeated circular motion: an ongoing, or continuous, event at that point in time [imperfective]

Repeated straight motion: a punctuated event that happens multiple times, or habitually [perfective]

http://www.start-american-sign-language.com/sign-language-instruction-asl2-4.html

Sign language properties

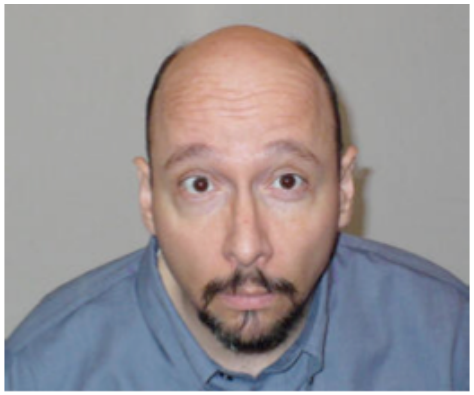
“I'd like to share with you a piano metaphor, to have you have a better understanding of how ASL works. So, envision a piano. ASL is broken down into many different grammatical parameters. If you assign a different parameter to each finger as you play the piano -- such as facial expression, body movement, speed, hand shape and so on, as you play the piano -- English is a linear language, as if one key is being pressed at a time. However, ASL is more like a chord -- all 10 fingers need to come down simultaneously to express a clear concept or idea in ASL. If just one of those keys were to change the chord, it would create a completely different meaning. The same applies to music in regards to pitch, tone and volume. In ASL, by playing around with these different grammatical parameters, you can express different ideas.” - Christine Sun Kim



https://www.ted.com/talks/christine_sun_kim_the_enchanting_music_of_sign_language
8:10-9:16

Sign language properties

But there are some similarities in simultaneous articulation…



Example: Y/N question + declarative utterance

Yes/no question face + regular declarative sign sequence

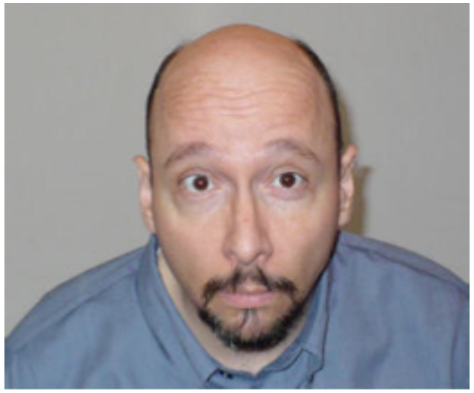
Spoken language equivalent: “echo question”
= Declarative sentence with question prosody

Example: “I can do it?”

Intonation as grammatical knowledge

http://www.sciencedaily.com/releases/2014/10/141023100428.htm

Intonation (as indicated by facial expression) differs from one sign language to another, just as other grammatical features differ from one sign language to another.



The situation

- Deaf individuals aren't all the same

- Deaf parents vs. Hearing parents
  - Deaf-of-deaf children (deaf children of deaf parents) are exposed to a full language immediately
  - Deaf-of-hearing children (deaf children of hearing parents) are exposed to "non-native" signers: they receive inconsistent and incomplete input

- Parents of deaf children also have to make a choice in how to teach their children

Manual / Oral / Total traditions

- Manual tradition
  - Teach sign language exclusively (at least at first)
  - Gives linguistic input from day 1

- Oral tradition
  - Force deaf children to learn spoken language
  - Delayed linguistic input, but potentially better communication with non-signers

- Total communication
  - Expose deaf children both to manual & oral language

Progression of sign language acquisition

Children pass through the same stages as in spoken language acquisition, in the same order: manual babbling to single-sign productions, to multisign combinations, followed by morphological development, more complex syntax, and learning appropriate intonation.

intonation acquisition: Brentari, Falk, & Wolford 2015:

https://www.sciencedaily.com/releases/2015/09/150928152344.htm

Progression of sign language acquisition

Children make the same kind of mistakes as in spoken language acquisition, such as

- overregularization errors in morphology (“goed”)
- ignoring parental corrections of form
- pronoun reversal errors (confusing what “I” and “you” mean) - despite these being signified by pointing gestures in signed languages, which seems naturally more iconic.

Oral language development

Deaf children are only exposed to lip movements

- This is really hard!

Mouth “Elephant shoes” vs. “I love you.”

vs. “olive juice” vs. “island view”

Oral language development

Phonological development: Deaf children differ during the babble stage from hearing children in both the quality and quantity of sound production. However, some orally trained children develop enough phonological awareness to identify rhymes from lip-reading.

Lexical development: oral vocabulary is delayed and proceeds more slowly.

Syntactic development: delayed, and endpoint of development falls far short of normal language competence.

John goes to fishing. Him wanted go. Who TV watched?

Who a boy gave you a ball? Tom has pushing the wagon.

Deaf children:
Only an issue when there's impoverished input

Deaf children exposed to sign language learn language the same as normal-hearing children

- There's no inherent deficit in language ability for deaf children

Deaf children exposed to spoken language learn much slower and never catch up to their normal-hearing peers!

- Deficit in spoken language, NOT in language generally

Cochlear Implants

- Cochlear Implants (CI): Allow certain deaf individuals to hear
  - CIs are controversial: treat deafness as a disease which can be “cured”
- How do they work?
  - Replaces the cochlea
  - Takes air pressure and turns it into neural signals

Cochlear implants: Sample speech

8-channel vocoded sentence

Normal sentence

Cochlear implants

- Why are cochlear implants interesting?
  - Explore how oral language develops after a lack of linguistic exposure
  - Effectively allowing these children to be second language learners of the oral language (so can potentially use the same approach as we use for investigating the critical/sensitive period with second language learners)

Cochlear implants

- How do these children do with spoken language?
  - Wide variability: some catch up to normal-hearing peers, some are unable to use their implants
  - Deficits appear to be due to auditory capabilities (which affects how good the auditory input is)

Cochlear implants

- How do these children do with spoken language?

  Note: Musical exposure can help increase spoken language perception for children with cochlear implants:

  “Hearing impaired children with cochlear implants who sing regularly have better perception of speech in noise compared to children who don't sing.” - Ritva Torrpa, on findings of Torppa, Faulkner, Kujala, Huotilainen, & Lipsanen 2018

https://www.sciencedaily.com/releases/2018/11/181127111009.htm

Cochlear implants

An important consideration about cognitive development with cochlear implants:
"The problem is that we can't reliably predict who's going to succeed with the spoken-language approach, and who isn't. By the time it's clear that a child's spoken language proficiency hasn't supported healthy development across the board, it may be too late for that child to master sign language." — Matthew Hall

https://www.sciencedaily.com/releases/2016/02/160213185702.htm

Cochlear implants

Predicting cochlear implant success and subsequent language development using fMRI and computational modeling:
Tan, Holland, Deshpande, Chen, Choo, & Lu 2015
Feng, Ingvalson, Grieco-Calub, Roberts, Ryan, Birmingham, Burrowes, Young, & Wong 2018.

"This study identifies two features from our computer analysis that are potential biomarkers for predicting cochlear implant outcomes…We have developed one of the first successful methods for translating research data from functional magnetic resonance imaging (fMRI) of hearing-impaired children into something with potential for practical clinical use with individual patients." - Long Lu

https://www.sciencedaily.com/releases/2015/10/151012141502.htm
https://www.sciencedaily.com/releases/2018/01/180115151559.htm

Late exposure to sign language

Delays in syntactic acquisition and language-based analogical reasoning: Henner, Caldwell-Harris, Novogrodsky, & Hoffmeister 2016

"Studies of Deaf adults have revealed that late acquisition of sign language is associated with lasting deficits…Ability in ASL was measured using a syntactic judgment test and language-based analogical reasoning test…Test scores were generally lower for Deaf children who entered the school of assessment after the age of 12…Our results reflect a continuum of outcomes which show that experience with language is a continuous variable that is sensitive to maturational age."

Deaf children: Bigger picture

Implication 1: Language is a property of the human brain, not a property predicated on the mouth and ears.

Implication 2: Since deaf children make the same mistakes in learning as hearing children - despite sign languages being more naturally iconic – this suggests that acquiring a formal grammatical system is a separate cognitive enterprise from learning how to communicate. If it wasn't, signed languages should be easier to pick up than spoken languages.

Deaf children: Bigger picture

Implication 3: While cochlear implants allow some deaf children to hear spoken language, there is wide variability in the ability to pick up the spoken language. However, this is a deficit in the spoken modality, rather than a language deficit - these children still have native-level proficiency in their signed languages.

Larger recap: Special Populations

Special populations let us test what matters and what doesn't matter for language acquisition:

- Visual cues: Not crucial for acquiring language (blind children)

- Auditory cues: Only crucial for acquiring spoken language (deaf children)

Questions?

You should be able to do up through 12 on the review questions and up through 3 on homework 6.