Ling51/Psych56L: Acquisition of Language

Lecture 16

Language in special populations

Announcements

HW 6 due today.

Review questions available for language development in special populations & HW7 due 12/1/16.

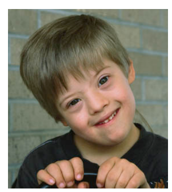
Review session in class on 12/1/16 for final

Final: 12/8/16, 1:30pm-3:30pm, in the normal classroom
or anywhere you have reliable internet access

Please fill out course evaluations

Remember that extra credit is available!

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 auditory input (deaf children)?

What if general intelligence is lower (mentally retarded children)?

[In extra material]

What about if there's no visual input (blind children)?

What if social abilities are lagging (autistic children)?

What about if only language abilities are lagging (specific language impairment children)?

Deaf children

Sign language

- Remember: Sign languages 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

Sign language

- Remember: Sign languages are just as complex as spoken languages - it's just that they're expressed with manual gestures and facial expressions, rather than spoken words.

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

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

Sign language

- Remember: Sign languages are just as complex as spoken languages - it's just that they're expressed with manual gestures and facial expressions, rather than spoken words.

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."

Sign language

- Sign languages like ASL do have some iconicity, where the signs resemble the concepts they represent.

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

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

Sign language features

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

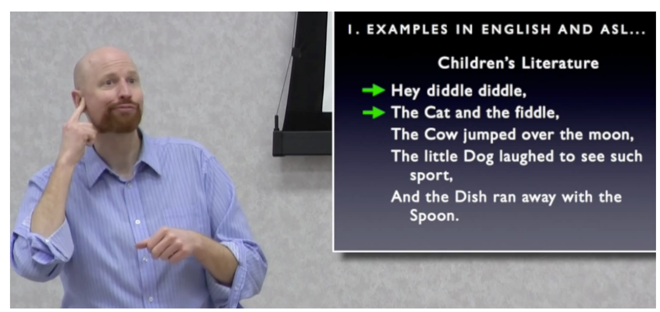
- handshape
- palm orientation (direction palm is facing)
- location
- motion

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.**

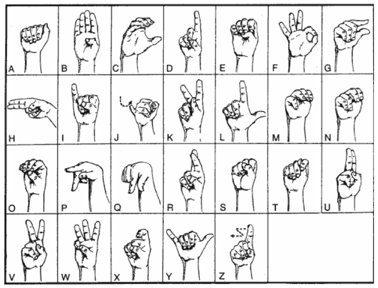
Sign language features make up words

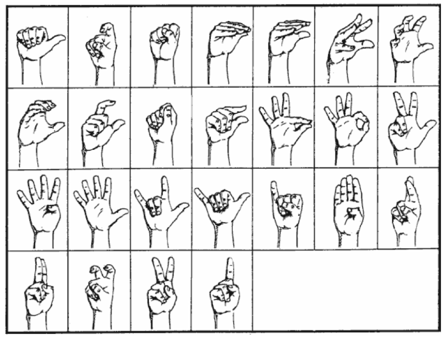
https://www.youtube.com/watch?v=rIoFpxAo93U
0:14 - 3:55

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

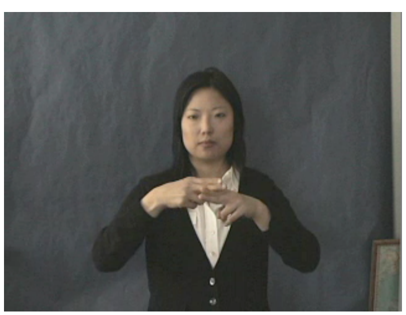
http://www.linguistics.ucla.edu/people/schuh/lx001/Discussion/d07b_videos_ASL_min_pairs.html

Ex: HOME vs. YESTERDAY

ASL signs differing only by palm orientation

http://www.linguistics.ucla.edu/people/schuh/lx001/Discussion/d07b_videos_ASL_min_pairs.html

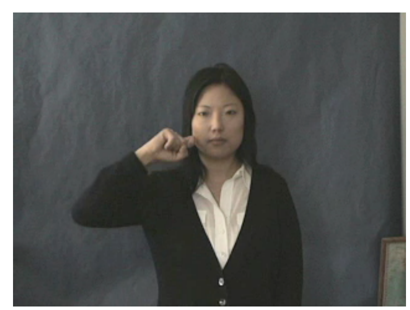
Ex: SOON vs. TRAIN



ASL signs differing only by location

http://www.linguistics.ucla.edu/people/schuh/lx001/Discussion/d07b_videos_ASL_min_pairs.html

Ex: APPLE vs. ONION



ASL motion types (and sub-types)

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

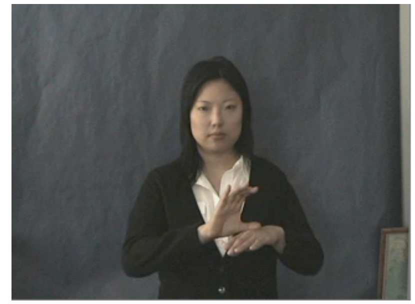
Internal: Opening the hand, closing the hand, bending at the wrist, twisting at the wrist, wiggling the fingers.

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.

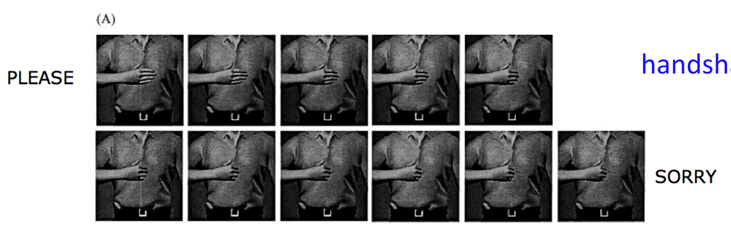
ASL signs differing only by motion

http://www.linguistics.ucla.edu/people/schuh/lx001/Discussion/d07b_videos_ASL_min_pairs.html

Ex: CHOCOLATE vs. CHURCH

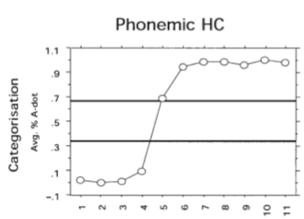


Signers have categorical perception of features



handshape

(Emmorey, McCullough, Brentari 2003)



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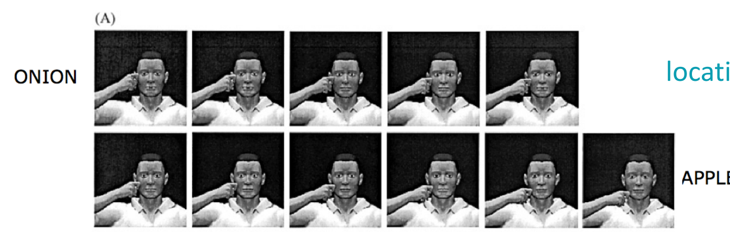
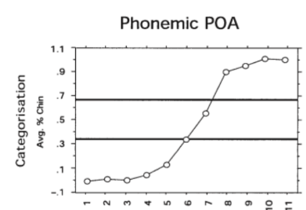


location

(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

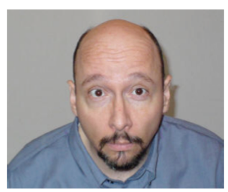
Sign languages allow for simultaneous articulation of information that spoken languages typically don't.

"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

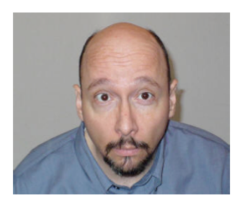
Spoken language equivalent: "echo question"
= Declarative sentence with question prosody

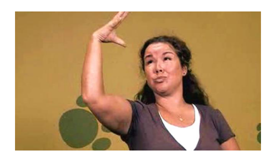
Example: "I can do it?"

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 are exposed to a full language immediately
  - Deaf-of-hearing children 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: Interim recap

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)

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

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Predicting cochlear implant success using fMRI and computational modeling: Tan, Holland, Deshpande, Chen, Choo, & Lu 2015

"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

Deaf children: Bigger picture recap

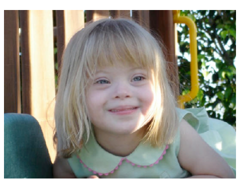
Implication 1: Language is a property of the human brain, not a property predicated on the mouth and ears.

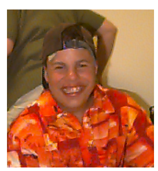
Implication 2: Since deaf children make the same mistakes in learning as hearing children - despite sign languages being more naturally iconic – this suggests that acquiring a formal grammatical system is a separate cognitive enterprise from learning how to communicate. If it wasn't, sign languages should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

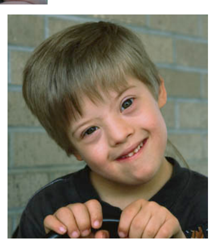
Deaf children: Bigger picture recap

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.

Mentally retarded children







A heterogeneous group

Mental retardation = "significantly subaverage general intellectual functioning…that is accompanied by significant limitations in adaptive functioning"

This lets us test how general intelligence aids language acquisition.

Research importance:

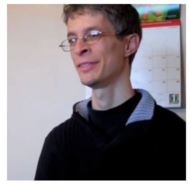
If language is the result of general cognitive abilities, mentally retarded individuals should have poor language.

If language is a specialized ability, it may be fine even if general intelligence is poor.

Williams Syndrome

Characterized by a well-defined set of approximately 25 genes missing on chromosome 7q11.23. (Landau & Ferrara 2013)

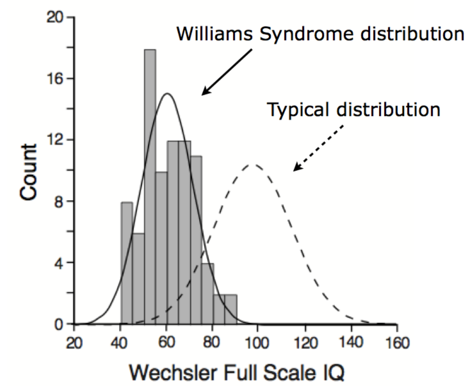
https://www.youtube.com/watch?v=AHT4-dB4MiI
~5 minutes total, especially 2:17-5:00



https://www.youtube.com/watch?v=AHT4-dB4MiI
~5 minutes total, especially 2:24-4:56

Williams Syndrome

Low general IQ (40-70), poor math, poor visuospatial reconstruction abilities



Williams Syndrome

Good language, often good with music, highly social

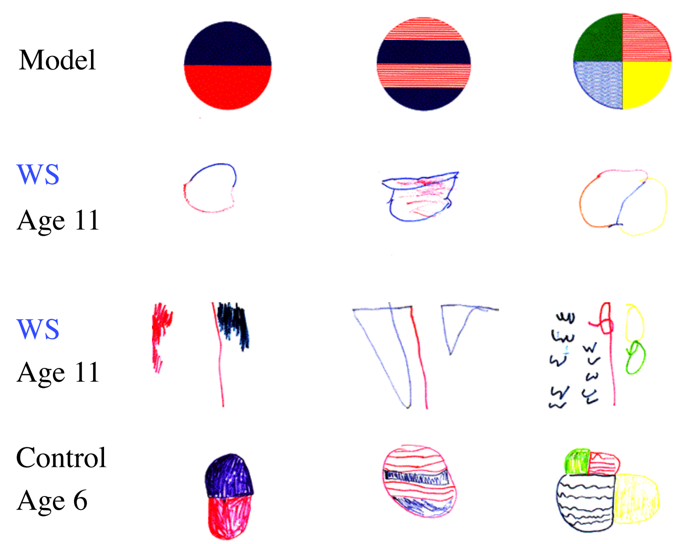
Lexicons tend to include more unusual words (and they like to use them).

Ex: "Tell me some animals".

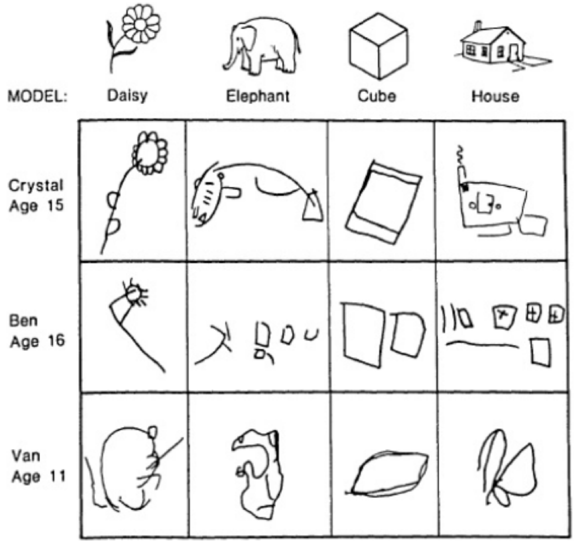
Williams Syndrome Answer: brontosaurus, ibex, koala, dragon, …

Often used to make the argument for the dissociability of language and cognition.

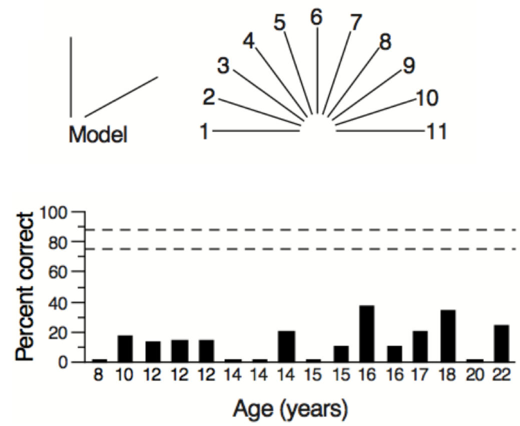
Williams Syndrome: Copying simple pictures



Williams Syndrome: Copying simple pictures

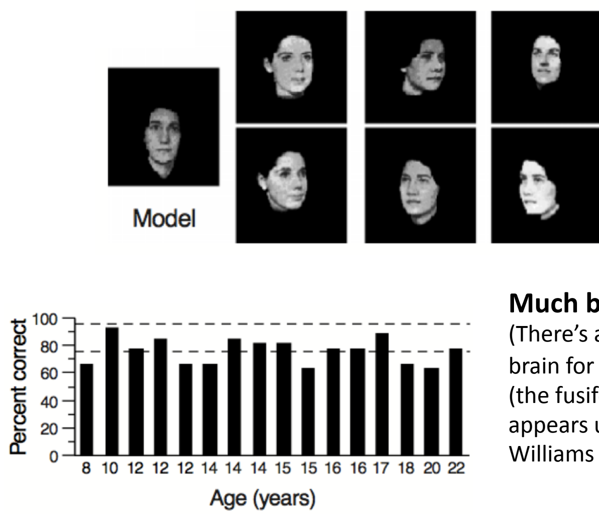


Williams Syndrome: Discriminating visual angles



Not so good…

Williams Syndrome: Discriminating faces



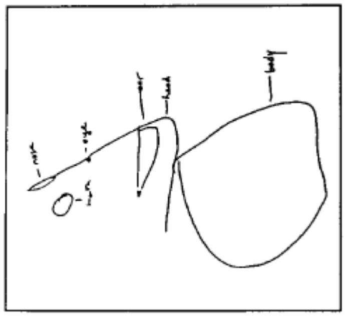
Much better!
(There's a specific area of the brain for facial recognition (the fusiform face area) which appears undamaged in Williams Syndrome.

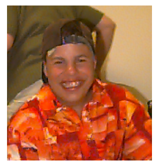
Williams Syndrome: Spatial development in general

A limit on Williams Syndrome spatial developmental trajectory

"Spatial functions that typically mature early (e.g., by age 4 or 5) are also observed to reach normal adult levels among people with WS, but those that typically show lengthier developmental trajectories appear to be arrested at an early functional level, with little change thereafter." — Landau & Ferrara 2013

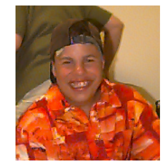
Williams Syndrome: “Draw an elephant”





Williams Syndrome: “Describe an elephant”

“And what an elephant is, it is one of the animals. And what the elephant does, it lives in the jungle. It can also live in the zoo. And what it has, it has long gray ears, fan ears, ears that can blow in the wind. It has a long trunk that can pick up grass, or pick up hay…If they’re in a bad mood it can be terrible…If the elephant gets mad it could stomp; it could charge, like a bull can charge. They have long big tusks. They can damage a car…it could be dangerous. When they’re in a pinch, when they’re in a bad mood it can be terrible. You don’t want an elephant as a pet. You want a cat or a dog or a bird…”



Describing complex pictures

Zukowski 2008

“Max is looking at the cow who um the boy’s pointing to.” (WS age 12;10)

Note: This level of syntactic knowledge is attained by typically developing children ages 5 to 6.

Understanding complex meaning

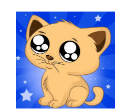
Musolino, Chunyo, & Landau 2010, Musolino & Landau 2010

WS adults can understand the difference between:

“The cat who meows won’t get a fish or milk.”

vs.

“The cat who doesn’t meow will get a fish or milk.”



Note: This level of syntactic & semantic knowledge is attained by typically developing children around age 5.

Williams Syndrome: Conclusive?

While their language skills are quite impressive in comparison to other cognitive abilities, they still lag behind those of typically developing children of the same chronological age.

The Developmental Arrest Hypothesis

"Developmental arrest would imply no further growth beyond this point. The arrest hypothesis suggests that structures typically acquired late in development may never be acquired by people with WS—or indeed, might be acquired in a way that fits 'late learning' by normal individuals." — Landau & Ferrara 2013

Williams Syndrome: Conclusive?

While their language skills are quite impressive in comparison to other cognitive abilities, they still lag behind those of typically developing children of the same chronological age.

The Developmental Arrest Hypothesis

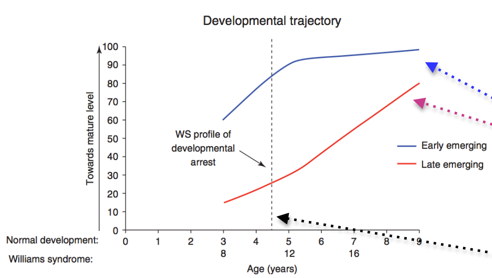
Supporting evidence for this hypothesis (Landau & Hoffman 2012, Karmiloff-Smith et al. 1997):

WS individuals never master late-developing linguistic knowledge like raising, certain passives, and other morphosyntactic knowledge acquired late by typically developing children.

Raising (implied subject): "She seems $_{she}$ to like penguins."

Williams Syndrome: Conclusive?

The Developmental Arrest Hypothesis



Landau & Ferrara 2013

Hypothetical developmental curves for early emerging spatial and language functions vs. late emerging spatial and language functions.

Williams Syndrome arrest point

"People with WS are hypothesized to undergo very slow development for both spatial and language functions, followed by arrest, resulting in a mature cognitive profile that resembles that of a typically developing 4–6 year-old."

Williams Syndrome: Conclusive?

In addition, while they may make grammatical errors similar to typically developing children (ex: contracting *wanna* when they shouldn't: **Who do you wanna win the race?),* they don't seem to recover from them the way that typically developing children do (Zukowski & Larsen 2012).

They also seem to produce more than they comprehend. Often they can't answer questions about the stories they just told.

Williams Syndrome: Implications

Excellent lexical development, phonological memory

+

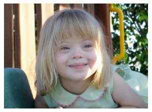
Poor performance on some aspects of late-developing grammar (and spatial ability)

=

Williams Syndrome children may acquire language differently than typically developing children, given the slower overall timeline and potential arrest of linguistic development.

The process is not the same (or at least gets stuck), and so the end result (language system) may not be not the same. Therefore, this may not be as decisive about the separation of typical language development from general intelligence.

Down Syndrome



Due to a chromosomal abnormality, and accounts for about one third of the moderately to severely mentally retarded population.

While some Down syndrome individuals achieve typical adult-linguistic competence, most do not. Language tends to be more impaired than other cognitive functions. Grammar is particularly impaired.

However, communicative development and pragmatic development are strong. Down syndrome babies vocalize more and engage in mutual eye contact more. School-age children are particularly interested in social interaction and less interested in objects.

Williams Syndrome (WMS) vs. Down Syndrome (DNS): Language

Williams Syndrome individuals do not show a deficit for putting together complex utterances while Down Syndrome individuals do.

(M. Mayer, "Frog Where are You")

WMS age 13

And he was looking for the frog. What do you know? The frog family! Two lovers. And they were looking. And then he was happy 'cause they had a big family. And said "good bye" and so did the frog. "Ribbit."

DNS age 13

There you are. Little frog. There another little frog. They in that... water thing. That's it. Frog right there.

WMS age 17

Suddenly when they found the frogs... There was a whole family of frogs... And ah he was amazed! He looked... and he said "Wow, look at these... a female and a male frog and also lots of baby frogs". Then he take one of the little frogs home. So when the frog grow up, it will be his frog... The boy said "Good bye, Mrs. Frog... good bye many frogs. I might see you again if I come arounmd again". "Thank you Mr. Frog and Mrs. Frog for letting me have one of your baby frogs to remember him".

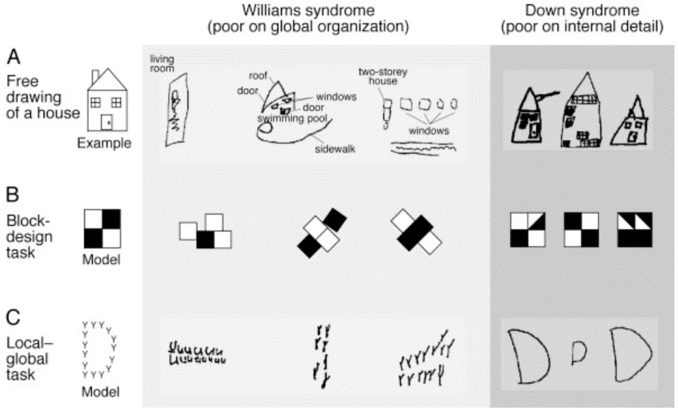
DNS age 18

Thy're hiding; see the frogs... the baby frogs. Uh, the boy, and, and the dog saw the frogs. The frog's got babies. The boy saw the... no, the boy say good bye.

(Reilly, Klima & Bellugi, 1990)

Williams Syndrome vs. Down Syndrome: Visuospatial abilities

Williams Syndrome individuals show a deficit for global organization while Down Syndrome individuals show a deficit for local detail.



Down Syndrome implications

Some language development (ex: grammar) is impaired.

One conclusion: Therefore language development requires general cognitive abilities. (Any other ways to interpret this if you're a nativist? Hint: Could a specific brain part be impaired too?)

Some language development (ex: communicative/social aspects) is not as impaired.

Therefore, "language" is not a single cognitive ability. Some aspects can be impaired while others are spared.

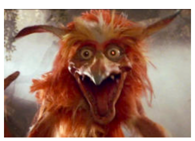
Also consider that "intelligence" is not a single ability. Down Syndrome may affect some aspects of intelligence but not others.

Recap: Special Populations

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

- Auditory cues: Only crucial for acquiring spoken language (deaf children)
- General intelligence: Potentially important for language acquisition, but not straightforward (Williams Syndrome, Down Syndrome)

Questions?








Don't forget:

- Review questions available for Special Populations.
- HW7 due 12/1/16 (it'll help you study for the final!)
- Final Exam Review – 12/1/16, in class.
- Final Exam – 12/8/16, in normal classroom or wherever you have internet access, 1:30pm-3:30pm.

Extra material

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/).

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.

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: Nonverbal 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.)

Autistic children

Characteristics of autism

Always: impaired language and communication

Includes: impaired social development, delayed and deviant language, insistence on sameness, and onset before age 30 months

Variability: Distinction between lower- and higher-functioning individuals; linked to nonverbal cognitive abilities

Language in lower-functioning autistics

Lower-functioning = ~80% of autistic individuals, scoring in mentally retarded range on nonverbal tests of development

~50% either do not speak at all or have echolalic speech, which is the meaningless repetition of a word or word group previously produced by another speaker

Some mixed success in teaching lower-functioning individuals when speech is combined with manual signs.

Language in higher-functioning autistics

Language success varies widely among higher-functioning autistics. In general, development is delayed and deviant in at least some respects.

Odd prosody: speech sounds mechanical (problems expressing emotional affect); possibly resulting from lack of attention to how others sound and/or a lack of interest in sounding like others

Gaps in semantics: autistic children do not use words that refer to mental states, such as *believe, guess, idea,* etc.; however, generally show similar understanding of other word meanings when compared with non-autistic children

Language in higher-functioning autistics

Language success varies widely among higher-functioning autistics. In general, development is delayed and deviant in at least some respects.

Gaps in syntax: autistic children use a narrower range of constructions, generally do not ask questions; however, development generally follows a similar course to that of non-autistic children

Severe communicative competence impairment: infants show little interest in people and no preference for their mother's speech, rarely produce pointing gestures, joint attention skills markedly deficient, make pronoun reversal errors

Autism: Implications

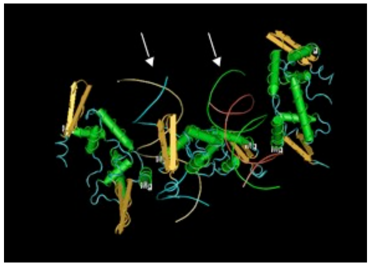
Impaired social abilities = impaired language, but crucially not the basic core of semantics and syntax

Idea: There is a dissociation between language acquisition ability and social/communicative abilities

One idea: Basic deficit is lack of theory of mind, and understanding people's minds is a prerequisite to true communicative behavior.

However…lots of overlap with specific language impairment children, so underlying deficit may not be so simple as that. Lack of theory of mind could be the result, not the cause.

Specific Language Impairment



Characteristics of Specific Language Impairment (SLI)

Speech from a 16-year old with SLI:

He want play that violin.

Can I play with violin?

Then he went home and tell mother - his mother - tell what he doing that day.

Then about noontime those guy went in and eat and warm up.

Characteristics of Specific Language Impairment (SLI)

In the absence of any clear sensory or cognitive disorder, language development is impaired.

FoxP2 gene on chromosome 7: impairment affecting jaw and tongue movement, speech, and grammar (tense, number).

Generally, these children show late onset of talking as well. Vocabulary development is typically delayed, but the greatest deficits are in morphology and syntax.

However, SLI children produce different kinds of grammatical errors than typically developing children – they may be learning differently than typical children

Characteristics of Specific Language Impairment (SLI)

Impaired phonological memory: SLI children are generally worse than typically developing children at repeating a meaningless sequence of sounds. (Remember, that was useful for predicting size of vocabulary in typically developing children.)

Nonlinguistic cognition impairment: worse at symbolic functioning, mental imagery, hierarchical planning, hypothesis testing, reasoning, drawing inferences from stories. Maybe SLI isn't so specific to language? (Though perhaps these are the result of a language deficit in some cases - without the ability to use language for cognitive-offloading, performance on these other tasks suffers.)

Accounting for Specific Language Impairment (SLI)

Idea 1: SLI children have an impairment in the language acquisition device (generativist viewpoint). Specifically, their innate knowledge about language is missing a piece.

Ex: Unimpaired children hear *walk*, *walked*, *jump*, *jumped*, and build a rule for forming the past tense (+ed). Children with SLI never use those regularities to build a rule. They just memorize the different forms. (This is similar to one idea about how Williams syndrome children develop, with the difference that Williams syndrome children have better associative memories for acoustic stimuli.) Crucial difference: even when SLI children lack the memory capacity for all the grammatical forms, something keeps them from learning the rule.

Accounting for Specific Language Impairment (SLI)

Idea 2: SLI children's phonological memory impairment means that they don't pick up on phonological information that is less salient, like unstressed grammatical morphology (Leonard 1989).

Ex: walk~walking, may be difficult for SLI children to retain in memory, and so they are delayed in picking up this information.

Note: doesn't necessarily account for all the differences between SLI and typically developing children.

Prediction: Should depend on the language - languages with more of this kind of less salient morphology should have more SLI kids. So far, sometimes yes, sometimes no.

Accounting for Specific Language Impairment (SLI)

Idea 3: SLI children can't process rapidly processed stimuli, like speech, as well as typically developing children.

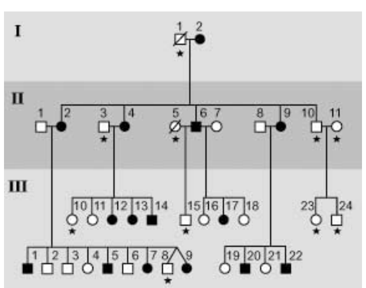
Ex: They can't process rapidly presented musical tones as well (Tallal 1978, Tallal et al. 1985), in addition to not being able to distinguish acoustic signals like dabiba vs. dabuba (Leonard et al. 1992).

Ex: They have trouble integrating the auditory and visual aspects of speech (Pons et al. 2013).

This ties in with the impaired phonological memory story, since children with a processing deficit will definitely have more trouble with less salient phonological cues like most grammatical morphology.

Genetic Factors in Specific Language Impairment (SLI)

There seems to be a familial concentration of specific language impairment. In the KE family, it turned out to be a single dominant gene at work (the FOXP2 gene).



SLI: Implications

Since language development seems to depend on many different underlying abilities, language impairment will likely have a number of different underlying causes.

It also may be that SLI simply represents the low end of the spectrum of language acquisition (Leonard 1987, 1991). SLI children show the same variability seen in typically developing children: some are weak in syntax but strong in pragmatics, some have the opposite pattern, and some are weak in both. Potential underlying problem: ability to extract regularities is significantly below average, which leads to many problems in language development (and elsewhere).

Larger recap: Special Populations

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

- Auditory cues: Only crucial for acquiring spoken language (deaf children)
- Visual cues: Not crucial for acquiring language (blind children)
- Social cues: Only crucial for pragmatics, maybe theory of mind (Down Syndrome, autistic children)
- General intelligence: Potentially important for language acquisition, but not straightforward (Down Syndrome, Williams Syndrome)
- Genetic factors? (SLI children)