THE SIGN LANGUAGE WINDOW ON LANGUAGE GENESIS

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Sample of Swedish Sign Language

So, what is your name? My name is Jenny Ingvarsson and this is my name sign. *Oh, how come? Why that particular name sign?* Well, first of all it indicates my curly hair, and when I was a small I always emphasized the ** when I fingerspelled my name, with real emphasis. My preschool teachers wanted to have a sign that only indicated my curly hair, but I wanted to add the ** so that is the combination. *Oh, it looks nice*. *Where are you from?* I was born in Stockholm. *Did you grow up here? So you are a real Stockholmer then?* Yes, I grew up in Stockholm and I still live in *Stockholm. Could you tell us a bit about your family and the time when you grew up?* Well, my father is hard of hearing and my mother is deaf. I have two brothers, one who is eighteen who is deaf, and one who is fifteen who is hearing.

Sign languages as full languages

- Full grammatical system
- Not derived from spoken languages
- Change as any other languages do

- In contact with spoken languages as result of social situation of Deaf people

Why are sign languages interesting for the question of evolution?

- Possible that SL's are forerunners of spoken languages

Or

- Both have their origins in a gestural system

Theories of language origins

Ding-Dong

- The origin of human language in onomatopoeia: imitative sounds that humans make to mimic the sounds of the world around them.

Bow-wow

- Humans formed their first words by imitating animal sounds.

Pooh-pooh

- The first words developed from sighs of pleasure, moans of pain, and other semi-involuntary cries These then became the names of the phenomena that made people say them.

Uh-oh

- human language begins with the use of arbitrary symbols that represent warnings to other members of the human band.

Theories (cont.)

Yo-he-ho

- language arose in rhythmic chants and vocalisms uttered by people engaged in communal labour.

Watch the Birdie

- human language became elaborated because humans found it advantageous to be able to *deceive* other humans. Since exclamations and vocalisms can involuntarily reveal your true mental state, humans learned to feign them in order to deceive others for selfish advantage.

Ta-ta

- According to this, human language represents the use of oral gestures that began in imitation of hand gestures that were already in use for communication.

View from:

Acquisition of sign languages (Anne)

Organization of sign languages in adults (Bencie)

Multimodality in languages

- Spoken languages use speech but are also accompanied by gesture & facial expression
- Sign languages combine manual signs with actions of other body parts:

eyebrows	eye gaze
head movements	mouth movements

Tools

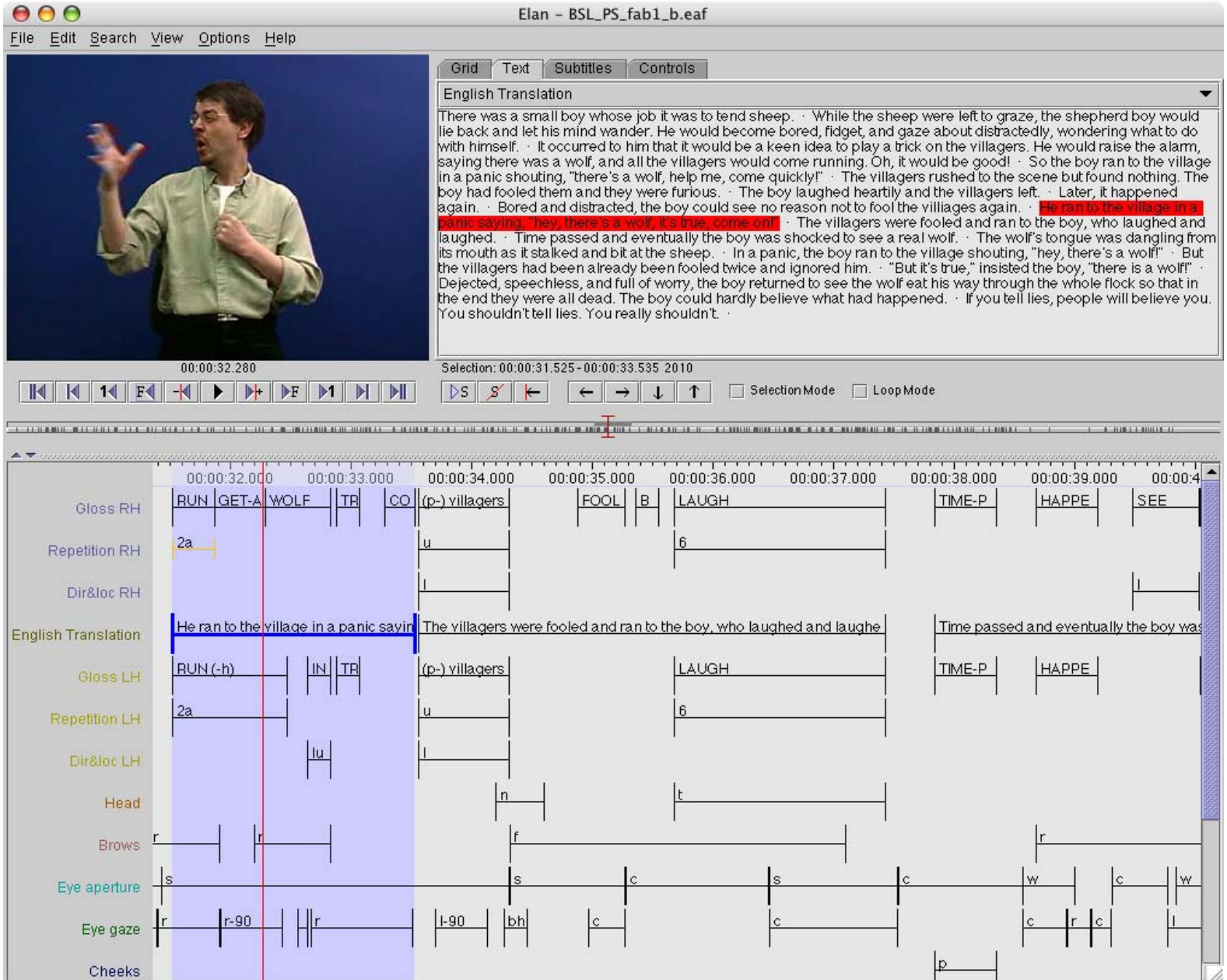
Developed by the Max Planck Institute in Nijmegen with the aim of managing data and metadata files

QuickTime™ and a TIFF (Uncompressed) decompresso are needed to see this picture.

- ELAN annotation software

- The IMDI (ISLE Metadata Initiative) Editor & Browser

Example of ELAN transcription



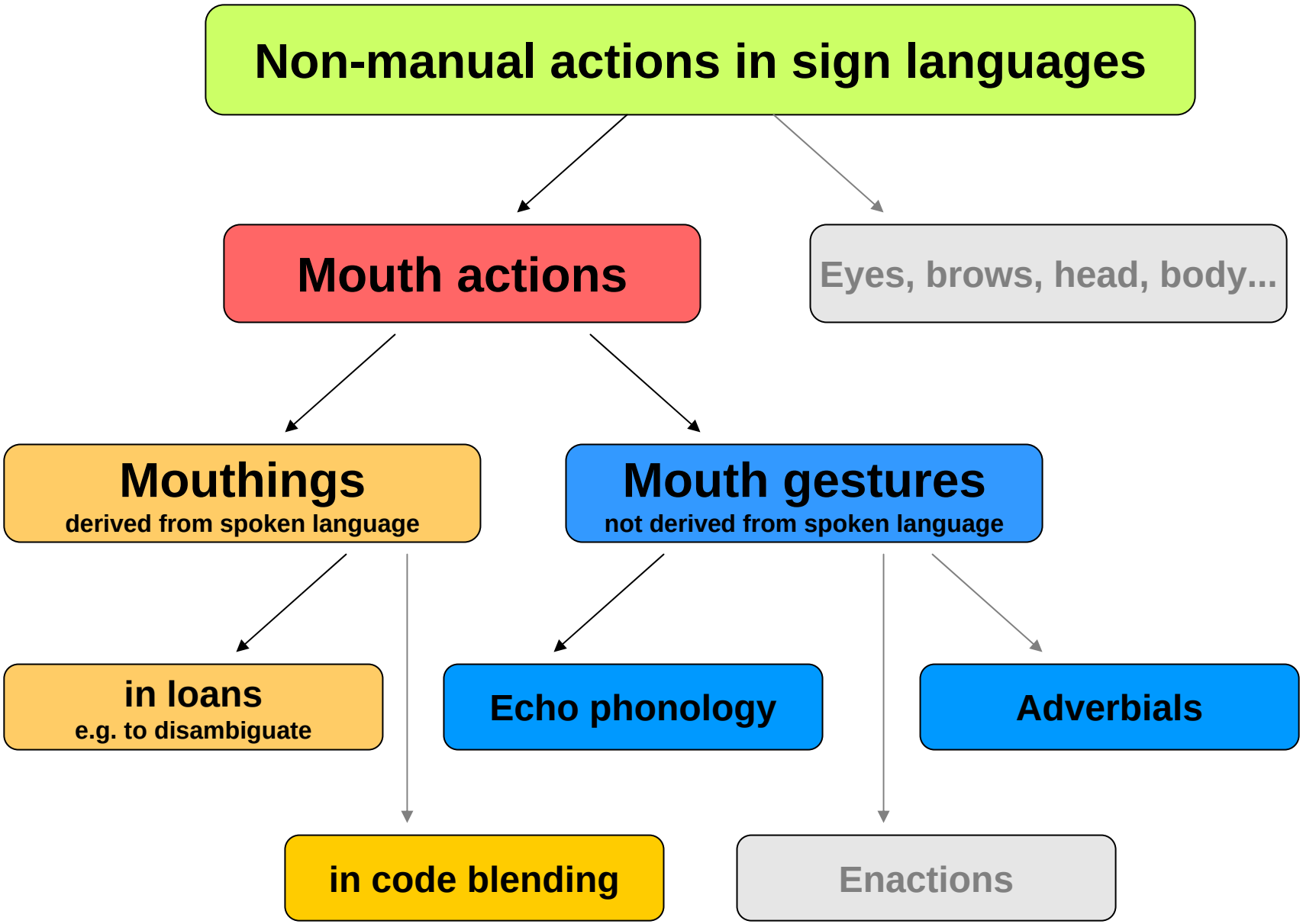
Acquisition of a signed language

Same stages as in a spoken language:

- Babbling before 1 year
- One-sign stage around 1 year
- Two-sign stage around 1year 6 months
- Multi-sign combinations from 2 years
- But variability between signed languages as to when specific structures are learned

Some claims that a sign language is learned more quickly

Video clip of Mark (3;6) and his mother in NGT


Non-manual actions in sign languages
Mouth actions
Eyes, brows, head, body...
Mouthings
derived from spoken language
Mouth gestures
not derived from spoken language
in loans
e.g. to disambiguate
Echo phonology
Adverbials
in code blending
Enactions

Use of mouth actions in signed languages

- Signs with mouth gestures not derived from spoken words

  e.g. “fa” in NGT sign FINALLY UNDERSTOOD

  “pa” in sign THROW AWAY
- Signs with mouthings, i.e. derived from spoken words

  e.g. “bal” in NGT sign BAL
- Latter can be seen as a form of code-blending.

Types of code-blending

(1) Dutch Base Language

Signed			VALLEN
Spoken	die	gaat	vallen
English	that	goes	fall

Translation *That [doll] is going to fall*

(2) NGT Base Language

Signed	$INDEX_{hij}$	JAS	BLAUW
Spoken			blauw
English	$INDEX_{he}$	COAT	BLUE

Translation *He has a blue coat*

Types of Code-blending cont'd

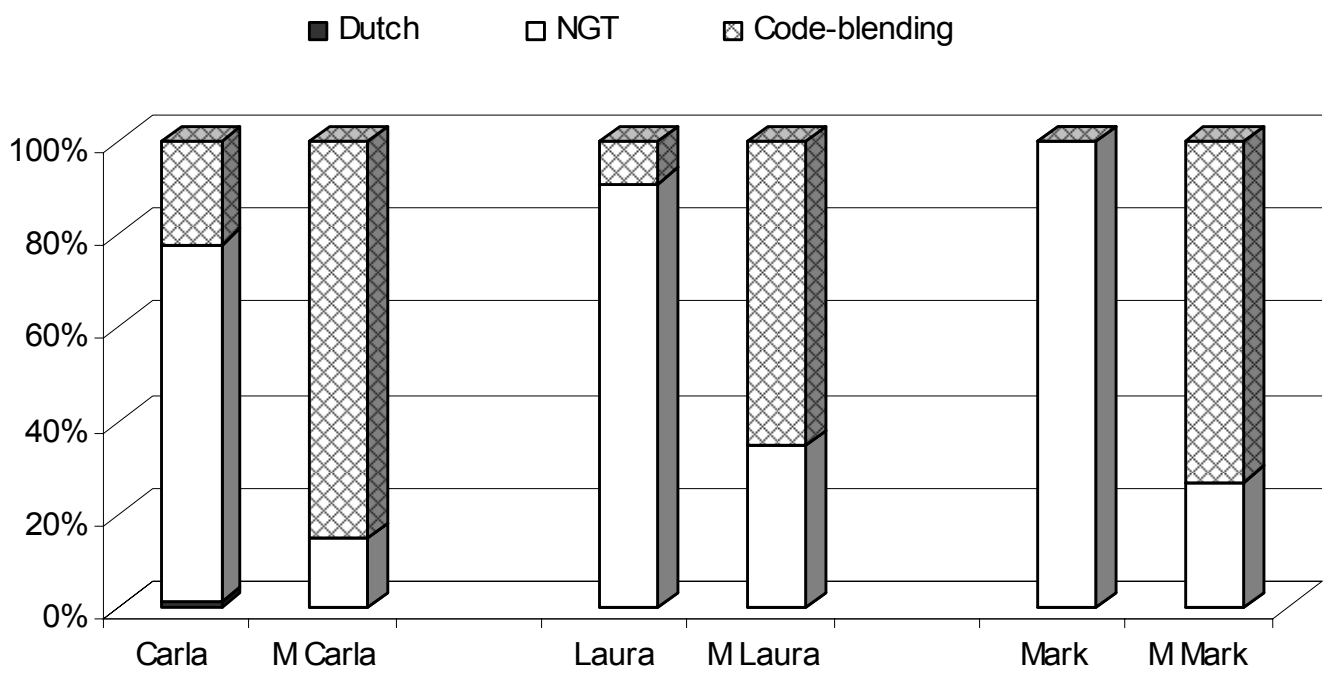
(3) Mixed

Signed	POP SPELEN
Spoken	geel
English	DOLL PLAY
	yellow

Translation (I want) to play with the yellow doll

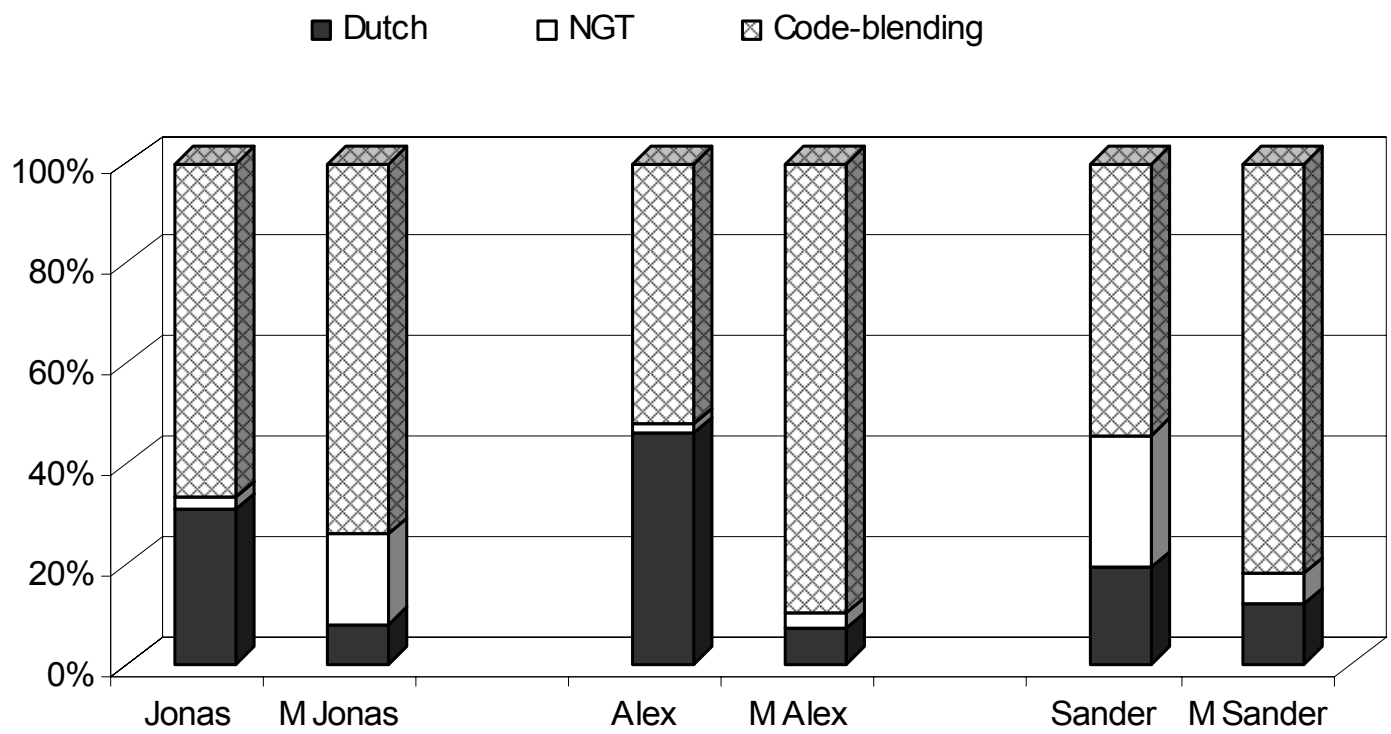
(4) Full

Amount of code-blending by 3 **deaf** children and their **deaf** mothers at 3;0



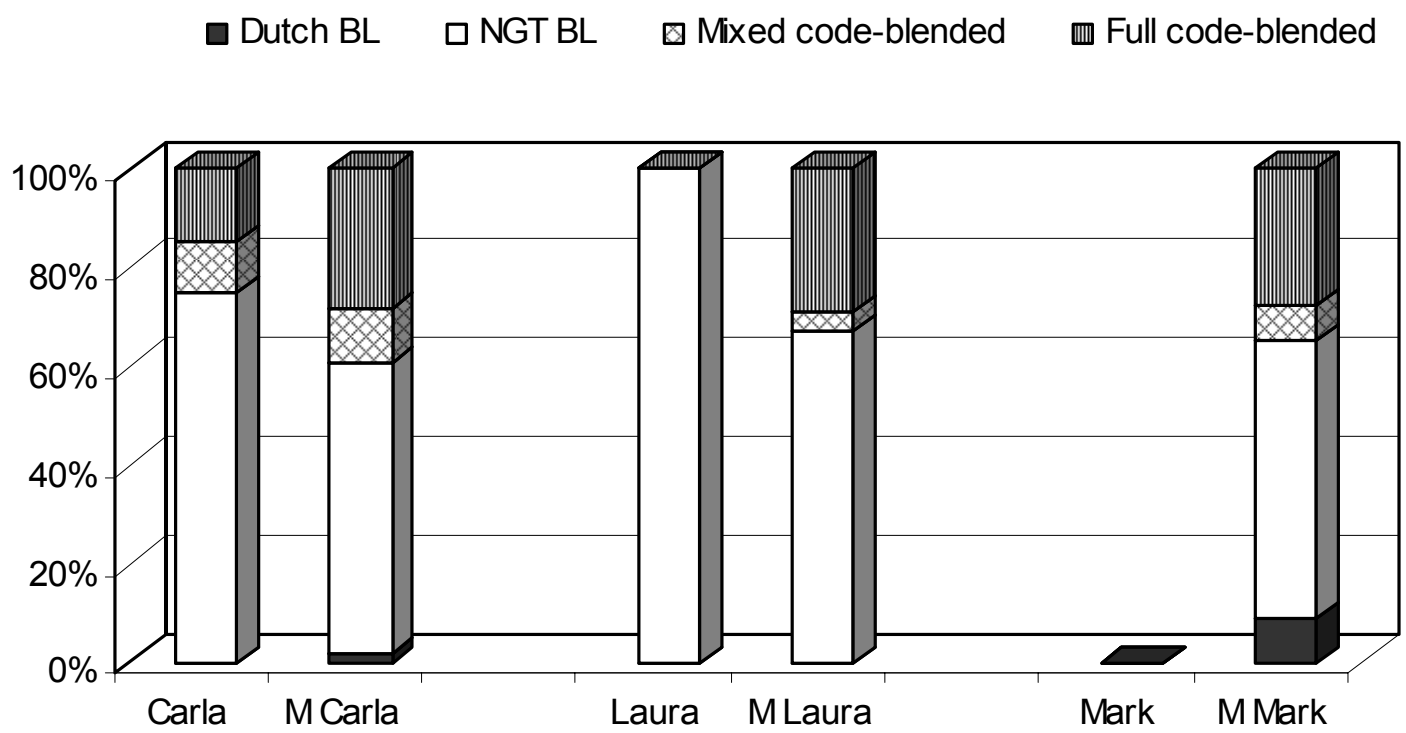
Mothers considerable amount; children little or none at 3;0.

Amount of code-blending by 3 **hearing** children and their **deaf** mothers at 3;0



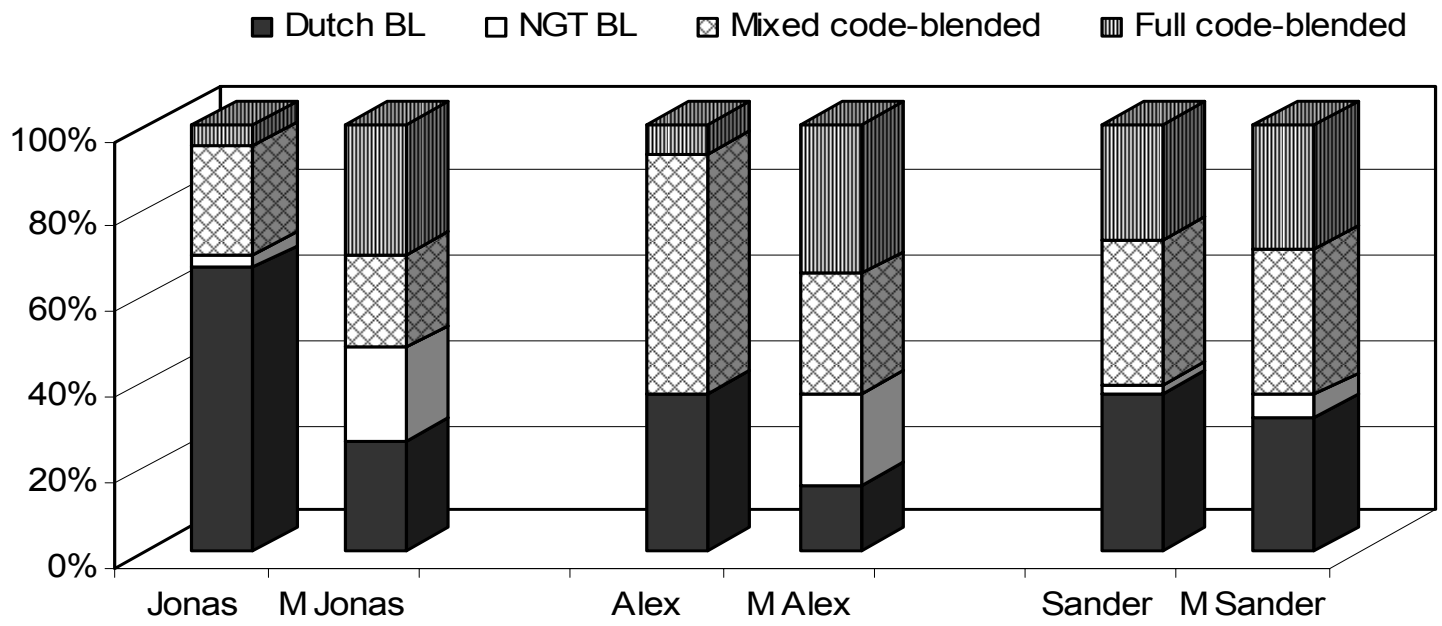
Mothers more than with deaf children; children also a considerable amount.

The types of code-blending by 3 **deaf** children and their **deaf** mothers at 3;0



Mothers have some mixture of types; Deaf children have mainly NGT based code-blends

The types of code-blending by 3 **hearing** children & their **deaf** mothers at 3;0



Mothers have a clear mixture of types; Deaf children also have a good mixture.

How to explain the **differences** between the deaf and hearing children

- Level of acquisition in the two languages
- Input
- Own language choice

Relevance to Windows project

At 3 years of age deaf and hearing children are behaving differently in their acquisition:

Amount of code-blending is different

Base language is different

Spoken language seems to be “driving” the hearing children and sign language “driving” the deaf children at this age.

What is happening in the earliest period of acquisition?

How are the two modalities combined from the beginning?

mouth actions + hand actions

mouth actions + signs

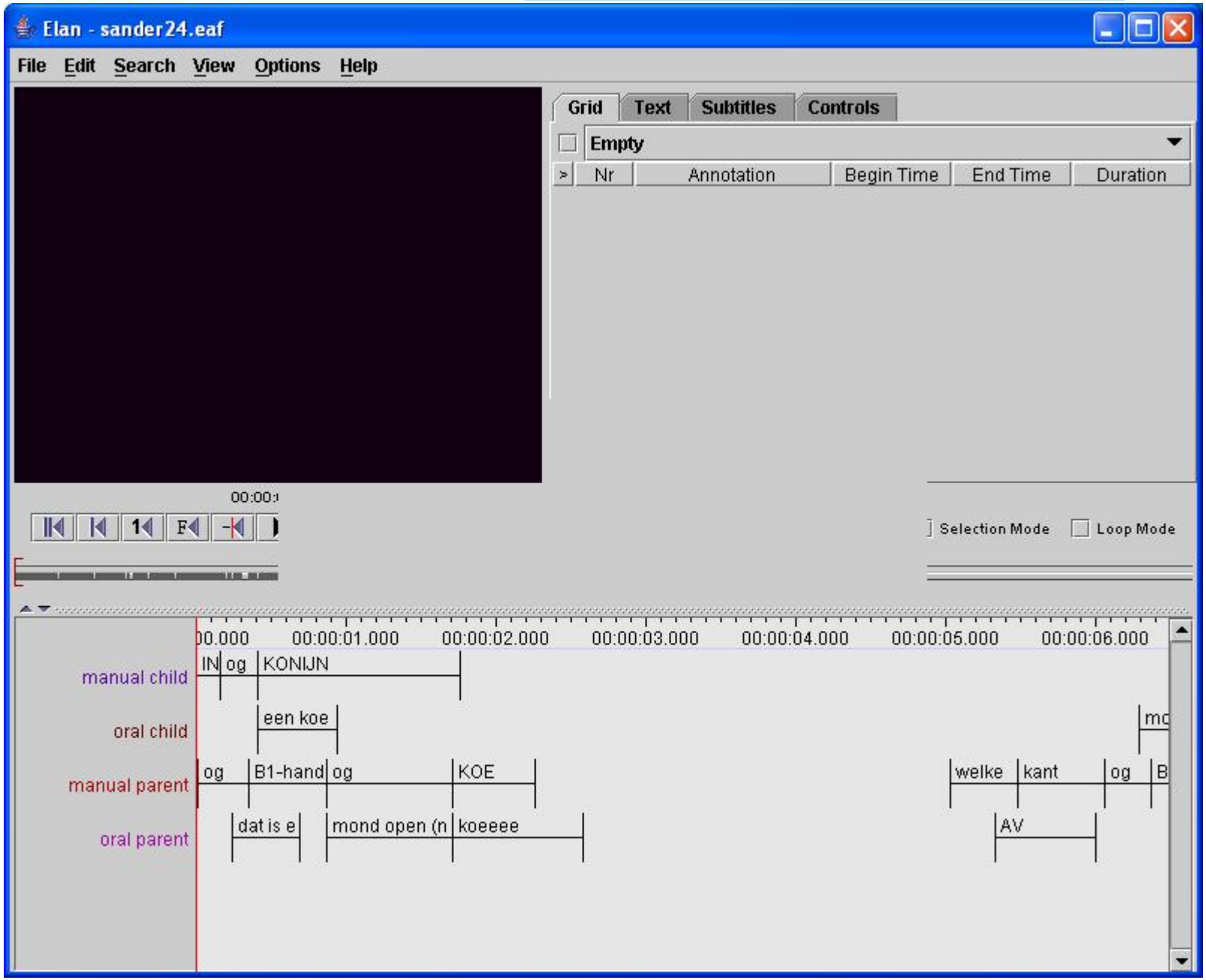
words + hand actions

words + signs

What is the timing in these combinations?

are mouth actions / words started earlier than signs or vice-versa? Is one “driving” the other?

Example of ELAN coding



Argumentation

If hearing children and deaf children are **different** in this very early period, then hearing status is clearly important and there is **no** universal pattern that could point to the original relationship between the modalities.

If they are **similar**, this might indicate that there is a universal pattern that suggests the origins of language.

The hands are the head of the mouth: echo phonology as a window on language genesis

Echo phonology

Woll (2001); used the term ‘echo phonology’ to describe a subset of mouth gestures that are driven by and parallel the movements of manual signs

Hand-mouth actions and speech

- Participants brought either a cherry or an apple to their mouth and pronounced the syllable BA or observed arm actions performed by the experimenter and pronounced the syllable BA. Execution and observation of the bringing-to-the-mouth action activate a mouth articulation posture which selectively influences speech production. This supports the idea that the system involved in speech production shares and may derive from the neural substrate which is involved in the control of arm-mouth interactions and, in general, of arm actions.

- Gentilucci, Santunione, Roy, Stefanini. Execution and observation of bringing a fruit to the mouth affect syllable pronunciation. European Journal of Neuroscience 19(1):190-202, 2004

Questions for signers with respect to mouth actions in sign language

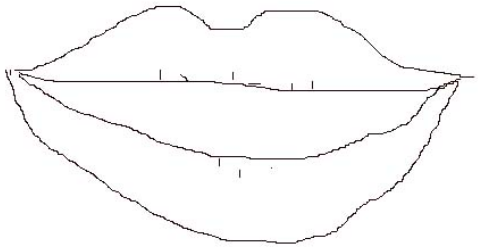
- How extensively are they used?
- Which brain regions are activated by watching mouth actions in sign language?
- Do these differ from those activated by watching spoken English?

Questions for non-signers

- Are these patterns the same as in signers?
- If they are not – how do they differ?

Two data sets

- ECHO project
- Imaging the Deaf Brain project



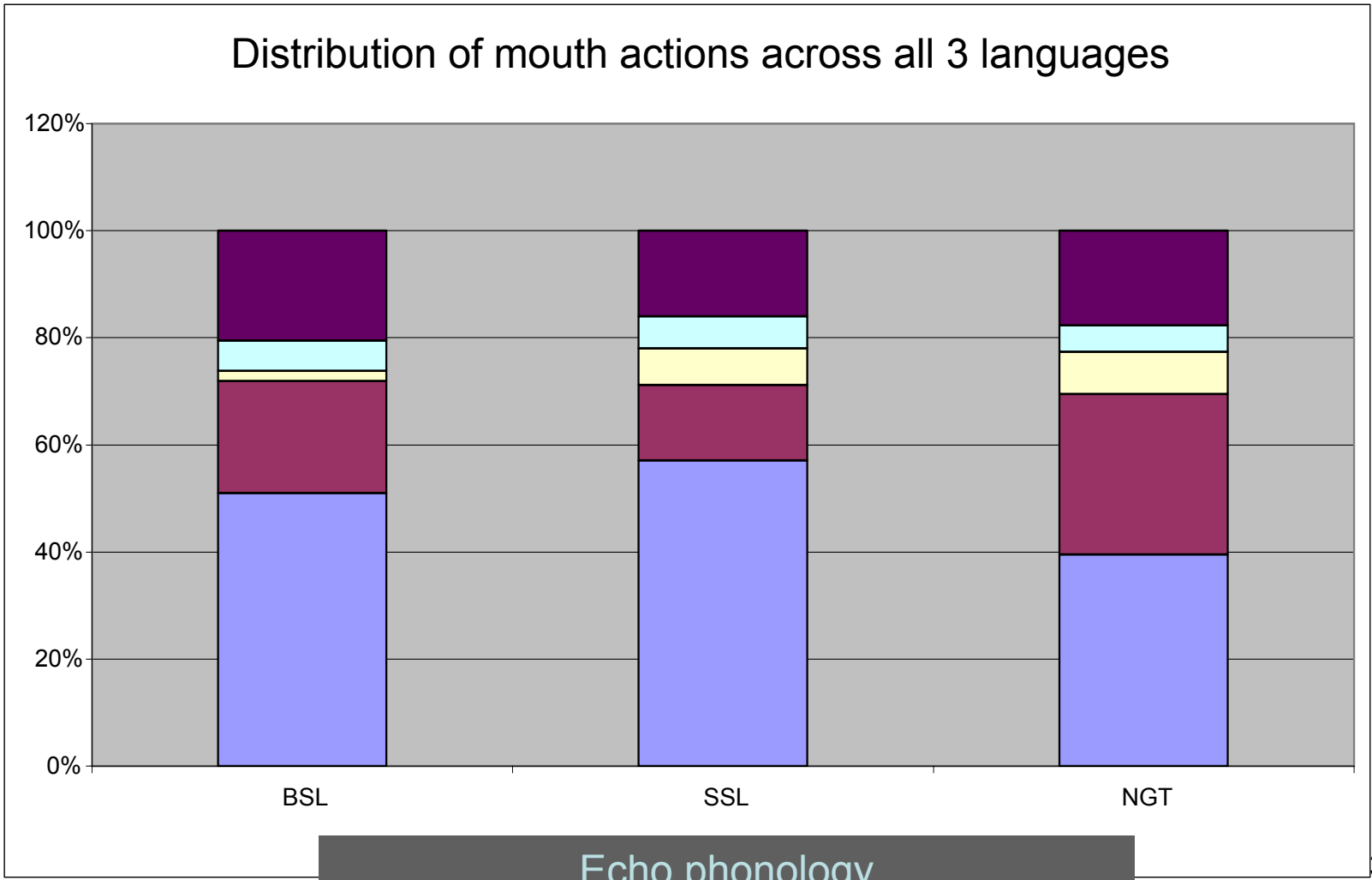
Mouth categories

- M mouthings
- E Echo phonology
- A adverbs (modifiers)
- 4 mouth for mouth
- W character markers (whole face)

Distribution: raw scores

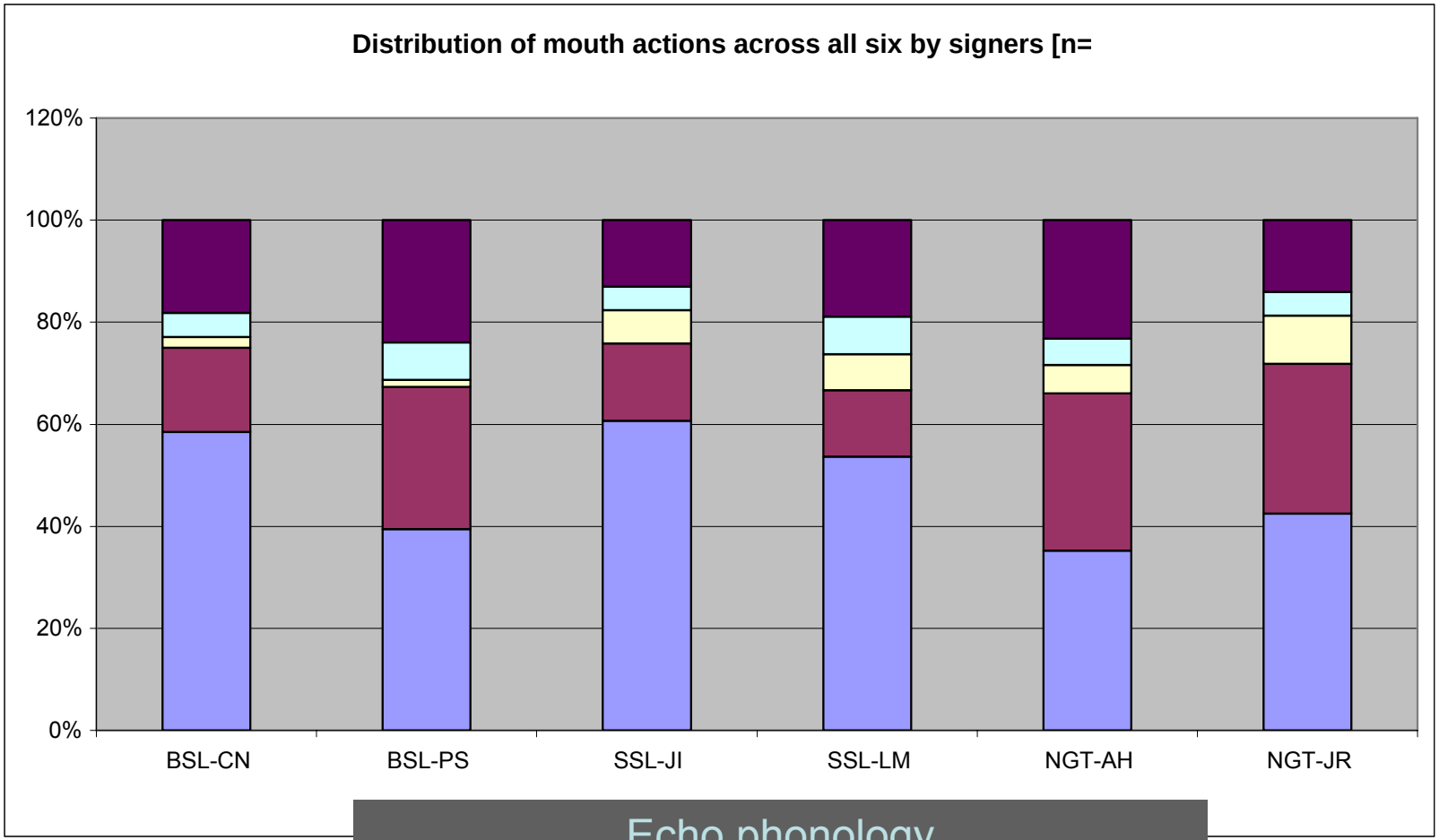
	M	**A**	**E**	**4**	**W**	
NGT	251	190	50	31	112	**634** (1056)
SSL	831	205	99	87	233	**1455**
BSL	560	231	20	63	225	**1099**

Distribution by language



Echo phonology

Distributions by signer



Echo phonology

Conclusions

- Echo phonology appears with comparable frequency across signers
- Echo phonology appears with comparable frequency cross-linguistically
- Similar ‘phonological’ repertoire

Brain Questions

- Which brain regions are activated by watching echo phonology?
- Is the processing of echo phonology similar to processing other sorts of sign language linguistic information?
- .. and what about speech?

fMRI studies

View 4 types of silent mouth actions –

- Echo phonology EP
- disambiguating mouth DM
- no mouth NM
- English (speechreading) SR

stimulus characteristics

	mouth opening and closing	hand- arm movements (BSL)	English derived mouth
EchoPhon	+	+	–
DisambMouth	+	+	+
NoMouth	–	+	–
Speechreading	+	–	+

Experimental stimuli

EchoPh	DisambM	NoM
EXIST [š38]	FINLAND/METAL	TABLE
[ɯ]WIN	BATTERY/AUNT	CHERRY
NONE [pu]	WOOD/PROBLEM	BUTTER
SUCCESS [pa]	RUSSIA/BOY	KNOW
END [pəm]	ITALY/WIN	FAX

In the scanner

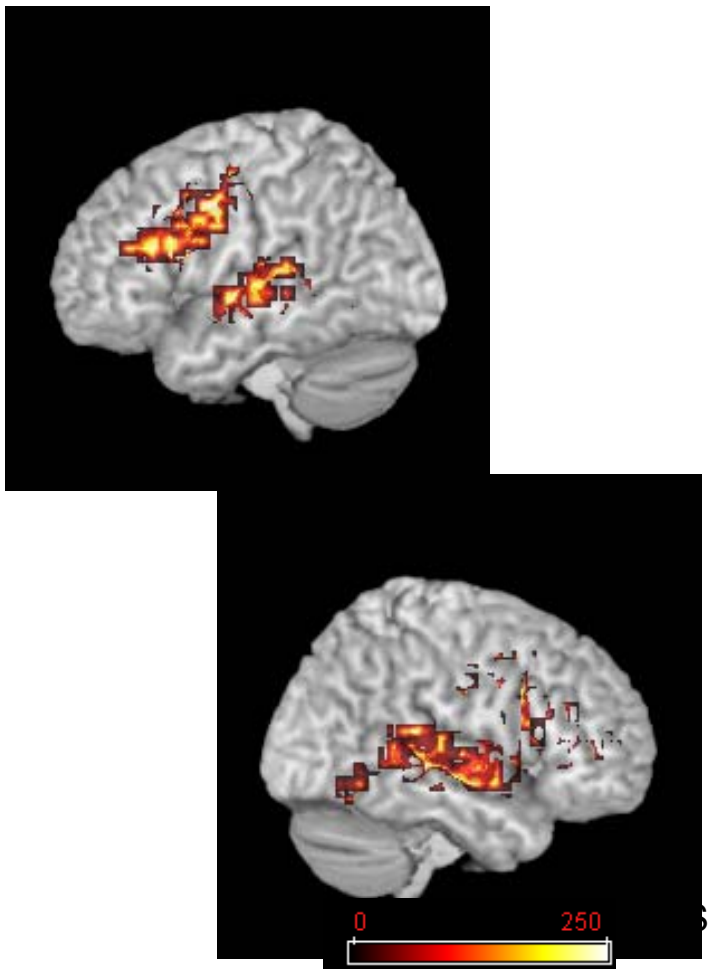
- Experimental task - Watch the actions and press the button when you see ‘yes’ – in sign language or in speech
- Baseline, press when the grey cross on the model’s face turns red
- Button presses sparse – once per block

General observations for signers -

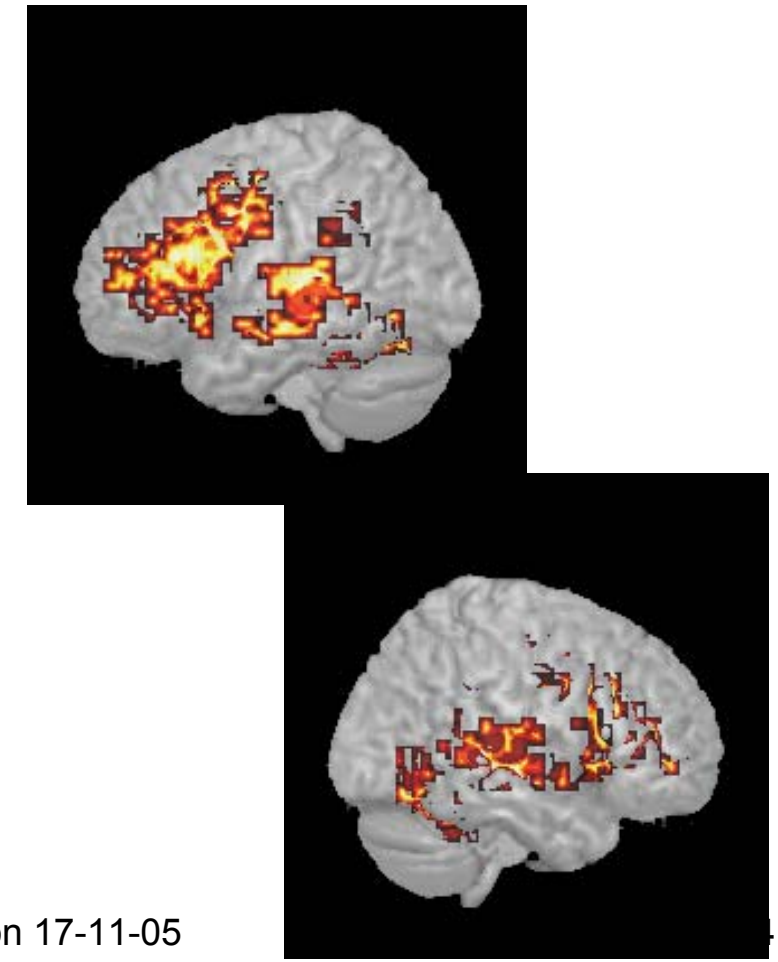
- Right Hemisphere is differentially sensitive to the articulators: lip and mouth movements are anterior; manual movements are posterior
- Left Hemisphere is NOT SENSITIVE to this at all

Speech-reading

Deaf signers



Hearing nonsigners

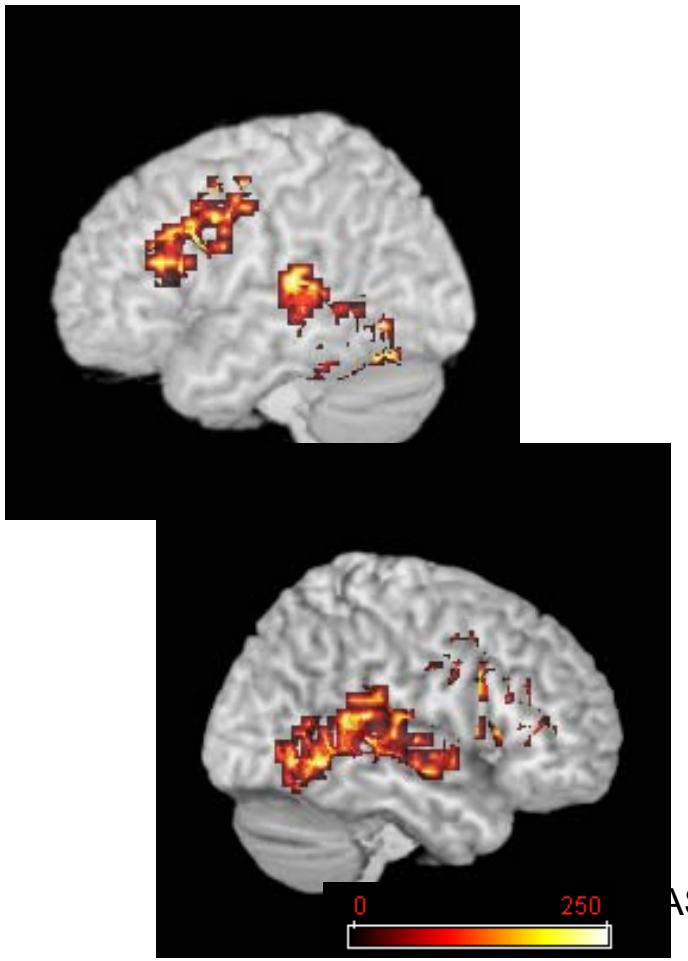


Interim conclusions – silent speech

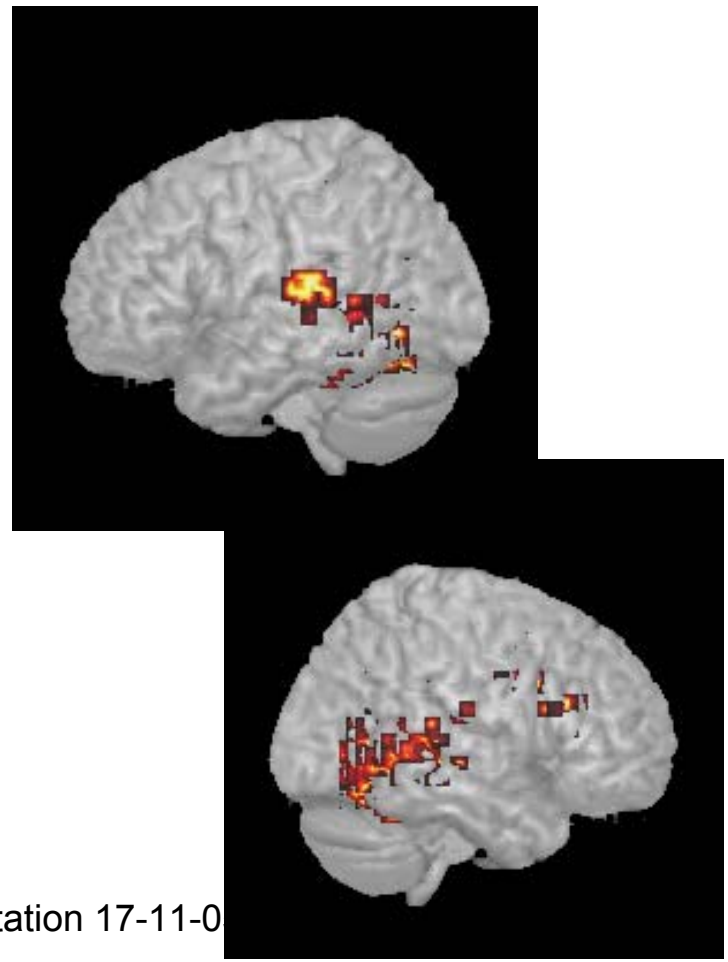
- These are very similar for deaf and hearing subjects
- Greater activation in frontal areas probably reflects more effort by hearing subjects to process silent speech (they are not used to speechreading but can do it)
- Although the stimuli are silent, both hearing and deaf subjects use left superior temporal regions (auditory cortex) for processing speech

No mouth

Deaf signers



Hearing nonsigners

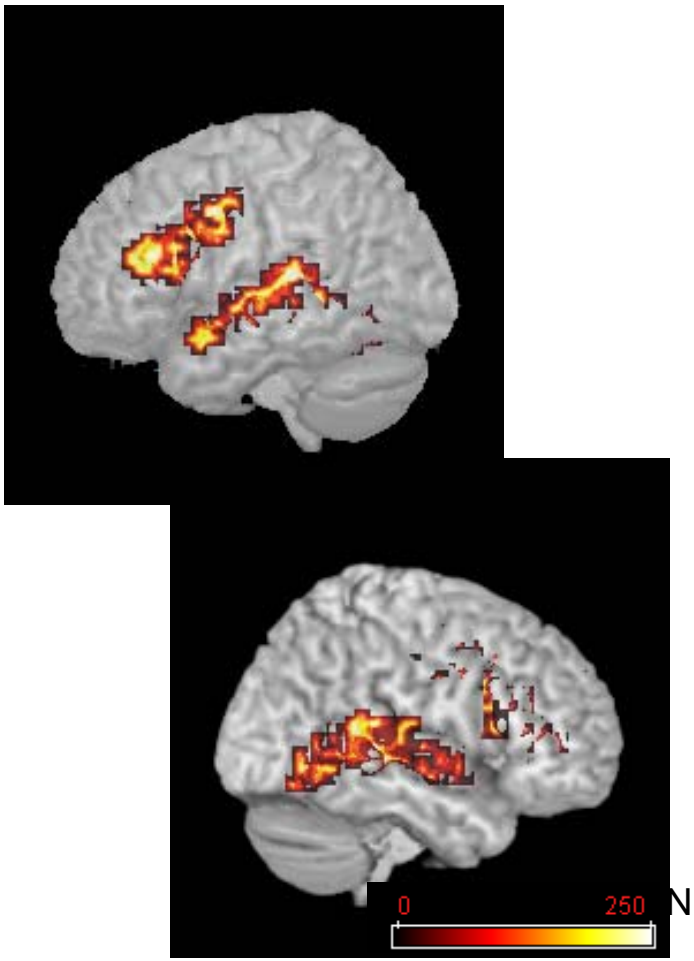


Interim conclusions – signs without mouth

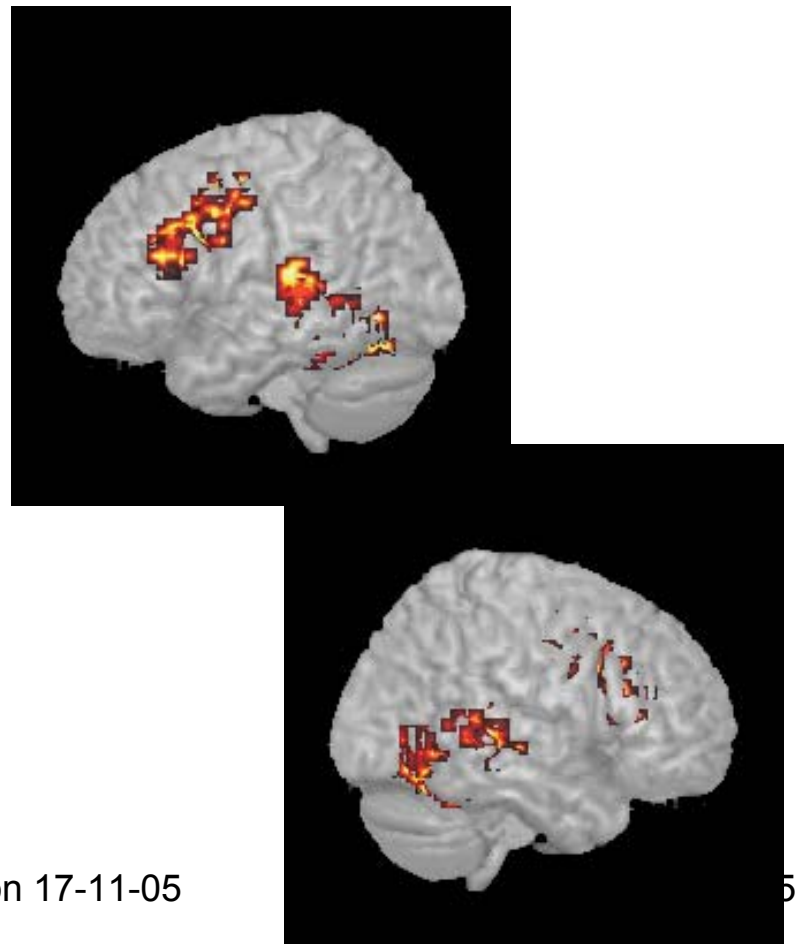
- LH activations are very different for deaf and hearing subjects.
- Total absence of frontal activation in hearing subjects probably reflects inability to access any linguistic meanings (they are not used to it and they can't do it)
- There is no obvious LH activation in auditory cortex in either deaf or hearing subjects

Echo phonology

Deaf signers



Hearing nonsigners



Interim conclusions – echo phonology

- For deaf subjects, LH activations strongly resemble those for processing silent speech. Echo phonology activates those areas of the brain used for processing phonology
- For hearing subjects, echo phonology processing does not activate auditory cortex
- Instead, there is extensive bilateral activation, which can include frontal regions in pre-motor sites

Conclusions

- The findings suggest that echo phonology occupies an intermediate position in terms of brain processing between signs and speech.
- This provides support to the notion that echo phonology may reflect a mechanism associated with language evolution
- Support for the ‘Ta-Ta’ theory?

Collaborators on the Acquisition project

Amsterdam University

Beppie van den Bogaerde, Roland Pfau, Marijke Scheffener, Joni Oyserman

Utrecht University

Jacomine Nortier

And all the families.

Collaborators on the ECHO project

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Stockholm University

Johanna Mesch, Brita Bergman

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Collaborators on Imaging the deaf Brain

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Jordan Fenlon
Tyron Woolfe
Zoë Hunter
Steve Williams and the imaging team