

# Methods and models in historical comparative research on signed languages

Justin M. Power, David Quinto-Pozos, Danny Law  
Department of Linguistics and Linguistics Research Center  
University of Texas at Austin

Model and evidence in quantitative comparative linguistics working group  
43rd Annual Conference of the German Linguistic Society (DGfS)  
University of Freiburg, Germany  
February 23-26, 2021

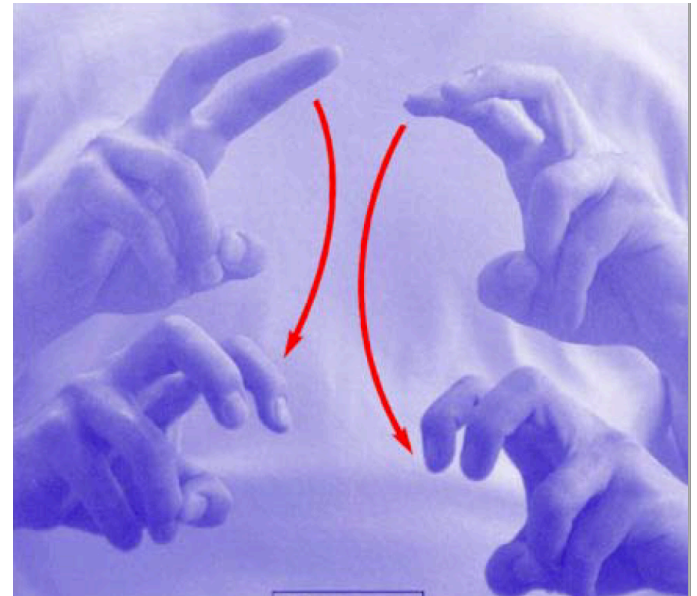
# Outline

1. Background on historical comparative research on sign languages (SL); past and recent approaches
2. Methodological challenges in comparative research on SLs related to sign representations
3. Approaches with and without models of sign change
4. Sign Change project

# Background: What makes up a sign?

- Signs have parts (*parameters*)
  - handshape
  - place of articulation
  - movement
  - orientation
- These parts/parameters are articulated simultaneously, although sequences can also occur

## TO-ANALYZE in ASL



From Meier, Cormier, & Quinto-Pozos, 2002

## Past approaches (1970s - 2000s) to historical comparative research on signed languages (quantitative)

- Targeted various sign languages (Australia, Costa Rica, Japan, New Zealand, Spain, Thailand, United Kingdom, the United States and the Arab world)
- Used a (modified) Swadesh list within a lexicostatistical framework
- Compared similarity of parameter values
- Did not appear to adopt the same notion of cognacy as for spoken language analyses
- Used similarity of form and meaning for cognacy, rather than an analysis of ancestral relationships

## Findings of past approaches (quantitative)

- Sign languages with related educational histories showed evidence of higher percentages of similar signs
- Sign languages **without related histories showed evidence of some similarity** of sign forms
- Questions raised about the influence of visual iconicity and gesture use in hearing society
- Some purported sign language families were advanced
- Questions raised about the role of language contact

# Past approaches to historical comparative research on signed languages (qualitative)

- Analyses of older and more recent signs of a single sign language
- Examples for ASL:
  - Frishberg (1975), Battison et al. (1975), Supalla & Clark (2015)
  - Examples of language-internal changes, following various principles, including:
    - Iconicity decreases
    - Efficiency of production increases
    - Semantic changes to signs occur

# Recent quantitative approaches to historical comparative research on signed languages

1. Yu et al (2018), Abner et al (2020):

comparison of 24 SLs from Asia (4), the Americas (2), Europe (17), and Oceania (1)

2. Börstell et al (2020):

comparison of 3 languages (two natural SLs:

SL of the Netherlands and Chinese SL; and International Sign)

3. Power, Grimm, & List (2020):

comparison of 76 manual alphabets from sign languages worldwide

# Methods and models in historical comparative research on SLs

## Methods

- Interoperability of sign representations
- Accessibility of historical comparative data

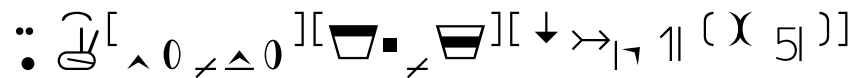
## Models

- Lack of a "gold standard"
- Lack of theoretically-informed models of sign change



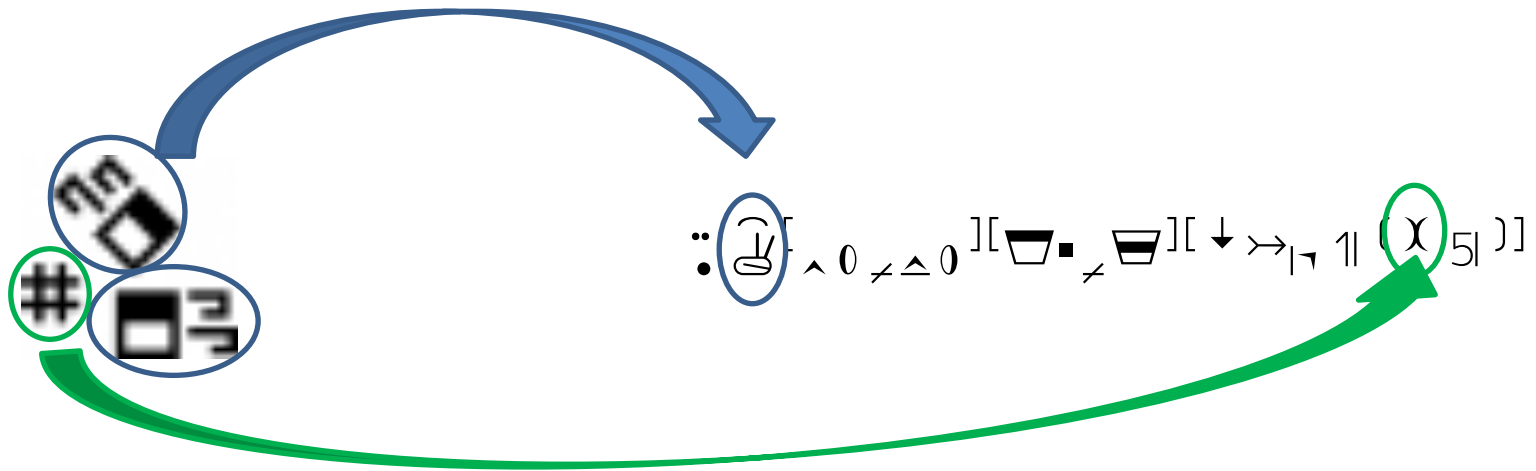
# Methods: compatibility of two main sign transcription systems

- two most widely-used sign transcription systems: SignWriting (Sutton 2011) and HamNoSys (Hanke 2004)
- systems encode formational features of signs in partly differing ways: spatially and sequentially



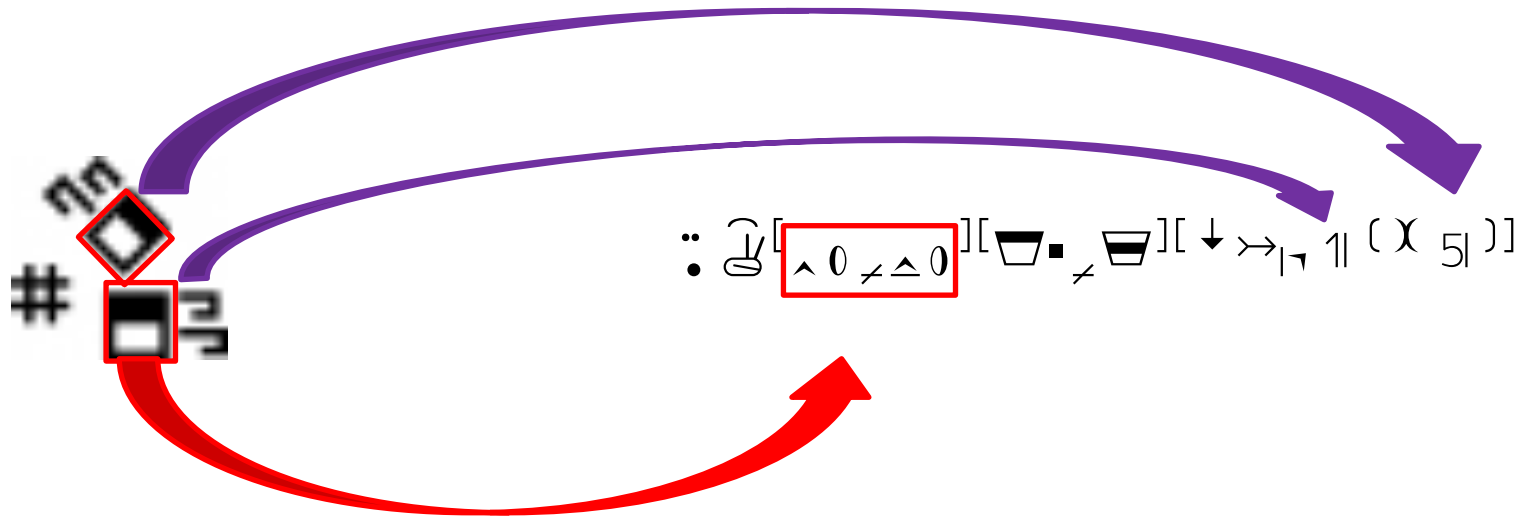
Sign in ASL meaning 'hard' in SignWriting (left) and HamNoSys (right)

# Methods: compatibility of two main sign transcription systems



Some aspects of the transcriptions are easily translatable across the two systems, including **handshape** and **contact**

# Methods: compatibility of two main sign transcription systems



Other aspects, such as **orientation** and **location**, may depend on the *spatial* arrangement of symbols in SignWriting but on *conventional sequential* arrangement in HamNoSys

# Methods: compatibility of sign representations in recent historical comparative approaches

- recent historical comparative approaches have used independently-developed annotation systems, instead of transcription methods

	Yu et al (2018), Abner et al (2020)	Börstell et al (2020)
handshape	55 values	64 values
HS change	binary	32 values
location	36 values	number ?
location		"relation between articulators"
contact		"contact type"
movement	"proximal movement": 6 values	"movement direction": number ?

Comparing sign representations in historical comparative studies: subset of sublexical comparanda in two recent quantitative approaches

# Models: challenges for historical comparative research related to theories of language change and language relationships

## Linguistic descent

- theories about language relationships among spoken languages have often relied on the notion of the unbroken generational chain of native acquisition (e.g., Ringe et al 2002)
- but transmission of sign languages occurs in fundamentally different ways; e.g., <10% of deaf children born to deaf signing parents (Mitchell & Karchmer 2004); the major role of deaf institutions in community formation and language transmission (Fenlon & Wilkinson 2015)

## Prevalence of iconicity in sign languages

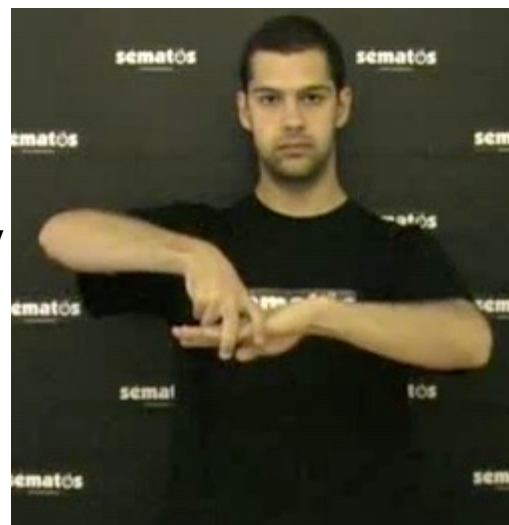
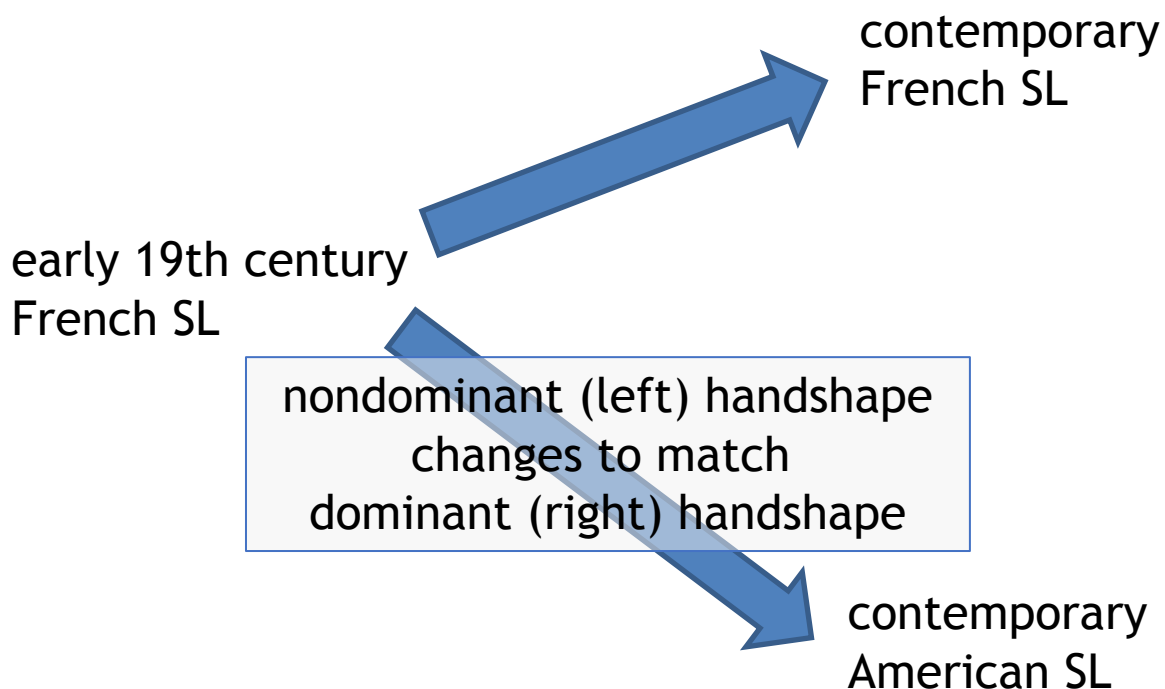
- If language change is sensitive to iconicity (Joseph 1987), the prevalence of iconicity in SLs (Guerra Currie et al 2002) may affect how SLs change

## Models: two main approaches in quantitative historical comparative research on signed languages

- approach (A) uses an implicit, theoretically-motivated model of *sign change* to inform cognacy judgments
- approach (B) uses an algorithm without a model of *sign change* for comparing signs based on a selection of sublexical features (or *parameters*)

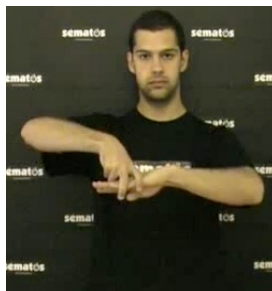
# Example of approach (A): model of *sign change* informs cognacy judgments

Change of type symmetry (Frishberg 1975)  
exemplified in two contemporary signs  
meaning 'to sit'



## Example of approach (B): comparison based on sign *parameters*, without model of change

- approach (B): signs may be cognate, depending on how signs are annotated/transcribed and on how similarity measures are interpreted



	LSF : ASL
handshape	dominant ✓, nondominant X
orientation	dominant X, nondominant ✓
location	X
movement	✓



## Problems for approach (A)

- 1. Lack of evidence:** large amount of research about language emergence, but few descriptive studies of diachronic change in established sign languages to inform models
- 2. No formalized model of sign change,** or descriptions of methods for judging cognacy
3. Points 1 and 2 create challenges for making consistent, theoretically-informed cognacy judgments

## Problems for approach (B)

1. **What are the comparanda?:** which sign parameters should be compared and at what level of phonetic detail?
2. **Similarity at the feature level may not be equivalent to historical relatedness:** lacking a model of sign change, are historical inferences warranted in this approach?

# Summary: problems for quantitative approaches in historical comparative research on signed languages

## Methods

- Interoperability of sign representations
- Accessibility of historical comparative data

## Models

- Lack of a "gold standard"
- Lack of theoretically-informed models of sign change

# Sign change project

- 3-year project, funded by National Science Foundation in U.S., with three main aims

DOCULECT	CONCEPT	HANDSHAPE	ORIENTATION	LOCATION	MOVEMENT
Brazilian SL	bad	☞	↺	↘(X 2)	↘#
French SL	bad	☞	↺	↘(X 2 3 4 5 6)	[[↘]]
French SL	bad	☞	↺	↘(X 2 3 4 5 6)	[[↘]]
American SL	bad	☞	↺	↘(X 2 3 4 5 6)	[[↘]]
SL Netherlands	bad	☞	↺	↘(X 2 3 4 5 6)	[[↘]]
SL Netherlands	bad	☞	↺	↘(X 2 3 4 5 6)	[[↘]]
Mexican SL	bad	☞	↺	↘(X 2 3 4 5 6)	[[↘]]
Mexican SL	bad	☞	↺	↘(X 2 3 4 5 6)	[[↘]]

1 create comparative database of transcribed signs from 13 languages in two putative SL families

2

apply Comparative Method to investigate whether phonological change has been regular in the evolution of these languages

3

develop theoretically-informed, quantitative model of sign change and phylogenetic relations

# Sign change project

1. Comparative database of signs from 13 sign languages in two putative language families: French family and B(ritish)A(uslan)N(ew)Z(ealand)SL family
  - transcribed using HamNoSys, one of the two main sign transcription systems, and freely accessible to other researchers
  - To date, approximately 1,900 signs transcribed from 7 languages, i.e., 50% of goal for sample

# Comparative database

DOCULECT	CONCEPT	HANDSHAPE	ORIENTATION	LOCATION	MOVEMENT
Brazilian SL	bad		< 0	∪ (X ∼)	✎ †
French SL	bad		^ 0	∪ (X 2 3 4 p ∼)	[ ✎ → >_ ]
French SL	bad	[  ]	[ ^ 0 ≠ 1 0 ]	[  ]	[ [ ← ∪ → >_ ( †    (X 5) ) ] ] ✎ ]
American SL	bad		r 0	∪ (X 2 3 p ∼)	[ ✎ → >_ ]
SL Netherlands	bad		^ 0		[ ↓ → >_ ]
SL Netherlands	bad		r 0	▪ ∪ ( ) ( 2 3 4 5 p̂ )	→ —
Mexican SL	bad		r 0	▪  (X    )	✎
Mexican SL	bad		^ 0	∪ ▪ (X 2 3 p ∼)	[ ✎ → >_ ( † ∪ ▪ (X 2 3 p ∼ ) ) ]

Selection of transcribed signs in comparative database from five languages

# Regularity of sign change

- apply steps of the Comparative Method to identify regular correspondences
- (NOT as straightforward as it sounds)

DOCULECT	CONCEPT	HANDSHAPE	ORIENTATION	LOCATION	MOVEMENT	SYMMETRY
French SL	hard		$r_0$		$[\downarrow \rightarrow \leftarrow 0 \sim \sim (\chi_3 \text{ 0})] +$	
American SL	hard		$[\wedge 0 \neq \triangle 0]$	$[\text{ 0 } \neq \text{ 0 }]$	$[\downarrow \rightarrow \rightarrow \uparrow \parallel (\chi_5)]$	••
Mexican SL	hard	$[\text{ 0 } \neq \text{ 0 }]$	$[\text{ 0 } \neq \triangle 0]$	$[\text{ 0 } \neq \text{ 0 }]$	$[[\downarrow \rightarrow \leftarrow 0 \parallel (\chi_3 \text{ 0})] \neq \diamond]$	
American SL	bone		$r_0$	$[\sim \neq \sim ] (\text{ 0 })$	$\updownarrow \sim (\chi \sim)$	••
French SL	bone		$r_0$	$[\text{ 5 } \neq \parallel ] (\chi \text{ 0 })$	$\rightarrow \text{ 0 } \text{ 0}$	••
Mexican SL	bone		$r_0$	$[\sim \sim \neq \sim \sim ] (\chi \text{ 0 })$	$\downarrow \text{ 0 } \text{ 0 } (\chi_2 \text{ 3 } \hat{\imath})$	••
American SL	sit	$[\text{ 0 } \neq \text{ 0 }]$	$[\wedge 0 \neq \perp 0]$	$[\text{ 0 } \neq \text{ 0 }]$	$[\leftarrow 2 \text{ 3 } \text{ 0 } \sim (\chi_2 \text{ 3 } \text{ 0 } \sim) \neq \diamond]$	
French SL	sit	$[\text{ 0 } \neq \text{ 0 }]$	$[\triangle 0 \neq \perp 0]$	$[2 \text{ 3 } \hat{\imath} \neq \sim ] (\text{ 0 })$	$[\downarrow \sim (\chi_2 \text{ 3 } \sim) \neq \diamond]$	
Mexican SL	sit		$\perp 0$	$[2 \text{ 3 } \sim \neq 2 \text{ 3 } \sim ] (\text{ 0 })$	$[\downarrow 2 \text{ 3 } \sim (\chi_2 \text{ 3 } \sim) \neq \diamond] \#$	••

# Identifying Correspondences











- putative handshape correspondence:

French SL  , 

Mexican SL  ,  , 

American SL  , 

i.e., handshapes with extended index and middle fingers, flexion of the interphalangeal joints, and opposed thumb

DOCULECT	CONCEPT	HANDSHAPE
French SL	hard	
Mexican SL	hard	
American SL	hard	
French SL	bone	 → 
Mexican SL	bone	
American SL	bone	
French SL	sit	
Mexican SL	sit	
American SL	sit	



# Fundamental questions

- Do supposedly universal processes of regular sound change have a correlate in sign languages?
- Are sign languages "related" to each other in the same way that spoken languages are?
- How should we define and identify phylogenetic relations between sign languages?

# References

- Abner, Natasha; Carlo Geraci; Shi Yu; Jessica Lettieri; Justine Mertz; and Anah Salgat. 2020. Getting the upper hand on sign language families: Historical analysis and annotation methods. *FEAST. Formal and Experimental Advances in Sign language Theory 3*: 17-29.
- Battison, Robin; Harry Markowicz; and James Woodward. 1975. A good rule of thumb: Variable phonology in American Sign Language. *Analyzing variation in language: Papers from the second colloquium on new ways of analyzing variation, part 3*, ed. by Ralph W. Fasold and Roger W. Shuy, 291-302. Washington D.C.: Georgetown University Press.
- Börstell, Carl; Onno Crasborn; and Lori Whynot. 2020. Measuring lexical similarity across sign languages in Global Signbank. *Proceedings of the LREC2020 9th Workshop on the Representation and Processing of Sign Languages: Sign language resources in the service of the language community, technological challenges and application perspectives*: 21-26.
- Fenlon, Jordan, and Erin Wilkinson. 2015. Sign languages in the world. *Sociolinguistics and Deaf communities*, ed. by Ceil Lucas and Adam C. Schembri, 5-28. Cambridge, United Kingdom: Cambridge University Press.
- Frishberg, Nancy. 1975. Arbitrariness and iconicity: Historical change in American Sign Language. *Language* 51.696-719.
- Guerra Currie, Anne-Marie P.; Richard P. Meier; and Keith Walters. 2002. A crosslinguistic examination of the lexicons of four signed languages. *Modality and structure in signed and spoken languages*, ed. by Richard P. Meier, Kearsy Cormier, and David Quinto-Pozos, chap. 9, 224-236. New York: Cambridge University Press.
- Hanke, Thomas. 2004. Hamnosys - representing sign language data in language resources and language processing contexts. *Lrec*, vol. 4, 1-6.
- Joseph, Brian D. 1987. On the use of iconic elements in etymological investigation: Some case studies from Greek. *Diachronica* 4.1-2: 1-26.
- Mitchell, Ross E., and Michael A. Karchmer. 2004. Chasing the mythical ten percent: Parental hearing status of deaf and hard of hearing students in the United States. *Sign Language Studies* 4.138-163.
- Power, Justin M.; Guido W. Grimm; and Johann-Mattis List. 2020. Evolutionary dynamics in the dispersal of sign languages. *Royal Society Open Science* 7.1-15.
- Ringe, Donald; Tandy Warnow; and Ann Taylor. 2002. Indo-European and computational cladistics. *Transactions of the Philological Society* 100.59-129.
- Sutton, Valerie. 2009, *SignWriting: Sign languages are written languages!* La Jolla, CA: The SignWriting Press.
- Supalla, Ted, and Patricia Clark. 2014. *Sign language archaeology: Understanding the historical roots of American Sign Language*. Washington: Gallaudet University Press.
- Yu, Shi; Carlo Geraci; and Natasha Abner. 2018. Sign languages and the on- line world online dictionaries & lexicostatistics. *Proceedings of the eleventh international conference on language resources and evaluation (lrec 2018)*, ed. by Nicoletta Calzolari, Khalid Choukri, Christopher Cieri, Thierry Declerck, Sara Goggi, Koiti Hasida, Hitoshi Isahara, Bente Maegaard, Joseph Mariani, Hélène Mazo, Asuncion Moreno, Jan Odijk, Stelios Piperidis, and Takenobu Tokunaga. Miyazaki, Japan: European Language Resources Association (ELRA).

# QUESTIONS?

Special thanks to:

- the sign transcription team



Aubrey Hinchman



Jenab Camara



Maggie Luhrman

- colleagues in the UT sign lab, for their helpful feedback

Project supported by NSF grant #1941560. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.