

# Modelling the social dynamics that lead to the emergence of shared sign languages

Connie de Vos    Seán Roberts  
 connie.devos@mpi.nl    sean.roberts@mpi.nl  
 Language and Cognition,  
 Max Planck Institute for Psycholinguistics

Bill Thompson  
 bill@ai.vub.ac.be  
 Artificial Intelligence Lab,  
 Vrije Universiteit Brussel



Vrije Universiteit Brussel



MAX-PLANCK-GESELLSCHAFT

**Shared sign languages** emerge in rural areas with high incidences of deafness from the informal interaction between deaf and hearing community members. Up to 96 percent of signers in rural signing communities are in fact bimodal bilinguals who use the sign language with varying degrees of sign fluency. Anthropological descriptions have pointed out several factors that may give rise to a shared sign language: community size, incidence of deafness, social structure, and marital patterns.

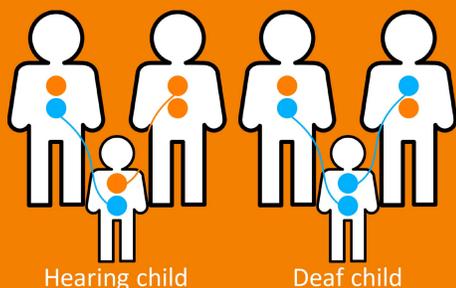
Since shared signing communities may vary considerably along socio-demographic dimensions, it remains a puzzle to what extent each of these factors contributes to the emergence of shared signing communities.

This paper uses **computational modelling** to assess the relative contribution of the following factors:

1. Community size
2. Social structure
3. Incidence of deafness
4. Marital patterns

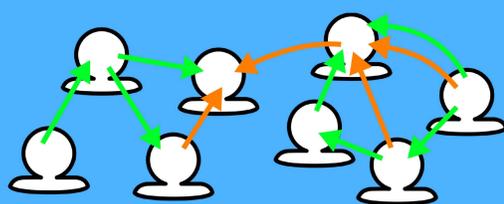
## Genetic Transmission

Individuals reproduce sexually. A proportion of individuals hereditary deafness caused by a recessive gene.



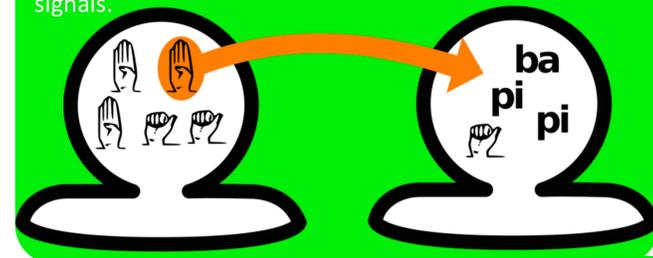
## A competition between the spread of genes and the spread of signs

Deaf genes spread by genetic transmission, and manual signs spread by cultural transmission. A balance between the rate of genetic and cultural transmission can lead to a shared signing community.



## Cultural Transmission

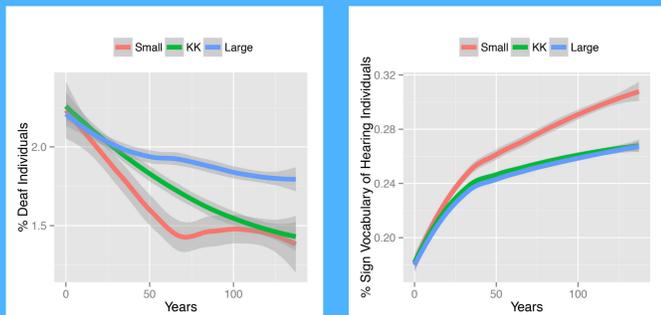
Individuals learn using an exemplar system: they remember signals observed in other individuals, and produce signals by selecting from the examples they remember. Hearing individuals favour the auditory modality. Deaf learners are unable to learn audible signals.



Model parameters are set to reflect the situation in the Kata Kolok community (KK). Different parameters are manipulated to see their effect on:  
 % **Deaf individuals**: The proportion of deaf individuals  
 % **Sign vocabulary of hearing individuals**: The proportion of visual to audible signals known by hearing people.

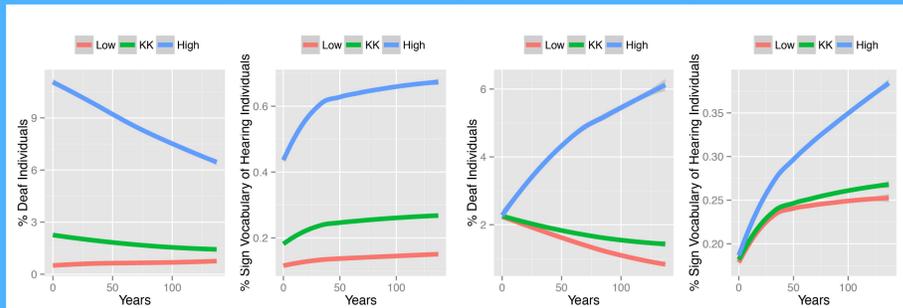
## 1 Community Size

Large communities can sustain higher proportions of deaf individuals, because deaf individuals dropping out of the community have a smaller impact. But small communities allow the spread of signs to happen faster.



## 3 Incidence of deafness

An initial lower incidence of deaf individuals means that the proportion of deaf people increases much slower, and signs spread slower through the community.



Initial proportion of deaf individuals

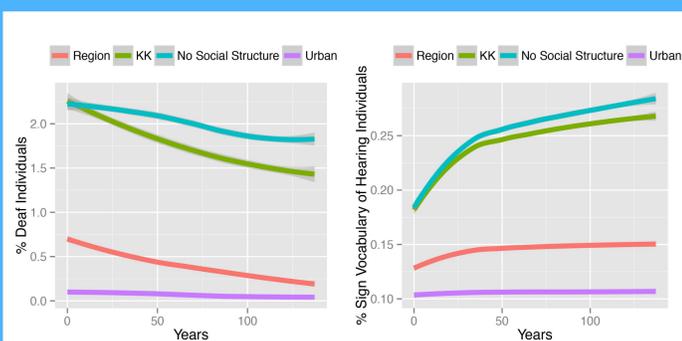
Initial proportion of deaf gene carriers

## 2 Social Structure

In the Kata Kolok situation, social interaction patterns are a function of gender, clan membership, neighbourhood, as well as deafness.

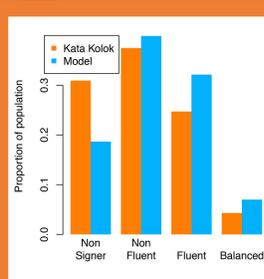
We compared the Kata Kolok situation with other situations, such as where any individual is equally likely to interact with any other (no social structure), or the general situation in the Buleleng region (lower incidence of deaf genes, lower probability of deaf individuals marrying).

The Kata Kolok community is more conducive to the emergence of a shared sign language than the Buleleng region, but the precise social structure may not be important.



## Fluency

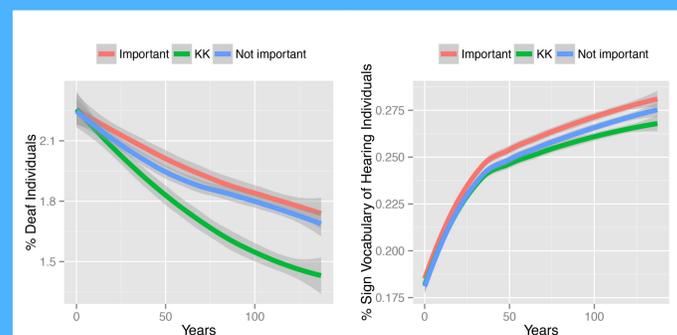
The model produces broadly the right distribution of fluency in the population, but under-estimates the number of non-signers, and over-estimates the number of balanced bilinguals.



## 4 Marriage Patterns

In the Kata Kolok community, deaf people are more likely to get married than hearing individuals, and are more likely to choose a deaf spouse when they do so. In some shared signing communities, genetic counselling has led to a taboo on deaf-deaf marriages. In our model we have varied this parameter by manipulating the importance of marrying someone you can communicate with.

Deaf-deaf marriages lead to a slower spread of signs through the population and lower incidences of deafness, while deaf-hearing marriages lead to a fast spread of signs throughout the population and higher incidences of deafness as a result.



## References

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## Systematically varied social settings

The default setting for the Emerging Languages Model were based on the genetic, anthropological, and sociolinguistic literature for Kata Kolok. Each of the other runs of the model systematically varied these parameters based on realistic reports in the literature while leaving others constant.

### Kata Kolok

Population size	2,189
Number of clans	10
Maximum compound size	25
Social interaction (relative weight)	
• with other deaf individuals	1
• with same gender	2
• within clan	3
• within compound	4
Incidence of deaf gene	0.176
Incidence of deafness	0.022
Chance at marriage	
• hearing individual	0.64
• deaf individual	0.85
Marriage attitudes (deaf)	
• Prefer deaf spouse	0.875
• prefer hearing spouse	0.125
Marriage attitudes (hearing)	
• Prefer deaf spouse	0.0013
• prefer hearing spouse	0.9987
Endogamy	TRUE
Patrilocal	TRUE

## Community size

1

To what extent is a small community size conducive or even necessary for the emergence of shared signing communities?

**Low:** With only 720 community members, Chican SL is one of the smallest attested shared signing communities (Escobedo Delgado 2012).

**High:** Alipur village, reportedly has as many as 20,000 inhabitants, but for current purposes the largest population size was set to 4,000 (twice the number of Kata Kolok) (Panda 2012).

Results from the model show that smaller communities allow the spread of signs to happen faster, but are also more vulnerable to natural fluctuations in the incidence of deafness.

## Emerging Languages Model

Interested in learning more about Emerging Languages Model?

Adapt the code or parameter settings to reflect the signing community you work with?

Please visit:

<https://github.com/seannyD/EmergingLanguagesModel>

## Language endangerment

Social isolation and endogamous marriage patterns are assumed to be necessary conditions for the emergence of shared signing communities. Conversely, an increase in exogamous marriages may lead to dilution of the deaf gene in the population, fewer deaf individuals being born, and language endangerment as a consequence (de Vos 2012).

In ongoing work we will manipulate the endogamy setting to see how changing marital patterns might effect the sustained use of sign language within the Kata Kolok context.

## Social structure

2

Marsaja (2008), Nonaka (2009), and Kisch (2012) note the high degree of social integration of deaf individuals in shared as compared to urbanized societies. To test this hypothesis whether social structure is crucial to the emergence of shared signing communities, we compare various situations.

**Kata Kolok:** Individuals have a higher likelihood of interacting when they are the same gender, clan members, neighbours, and when they are both deaf.

**No social structure:** the relative weight of each social interaction parameter is equal.

**Region:** Reflects the general situation in the wider Buleleng region (lower incidence of deaf genes, lower probability of deaf individuals marrying).

**Urban:** Reflects the demographic and socio-cultural situation in urban signing communities.

The model accurately predicts the absence of a shared signing community in urban contexts as well as the wider Buleleng region. The results from the model also suggest that, all other things being equal, signs may spread more rapidly in communities without a social structure, since deaf individuals freely communicate with all other individuals in the community.

## Incidence of deafness

3

**Low:** In rural areas of developing countries, the incidence of congenital deafness is up to 5 times higher (0.05%) than in developed countries.

**High:** The incidence of deafness in shared signing communities may fluctuate considerably over time, peaking at a reported 11% in the Adamorobe (Ghana) in 1961 (Kusters 2012).

Results from the model show that an initial lower incidence of deaf individuals means that the proportion of deaf people increases much slower, and signs spread slower through the community.

## Marriage patterns

4

In the Kata Kolok community, deaf people are more likely to get married than hearing individuals, and are more likely to choose a deaf spouse when they do so. Shared signing communities may vary considerably along this anthropological dimension. In Alipur village, for instance, all marriages are arranged to be between deaf and hearing individuals (Panda 2012). In other cases, such as Adamorobe, genetic counselling has led to a majority of deaf-hearing marriages, while leaving some deaf individuals unmarried (Kusters 2012). To reflect these different situations, we have manipulating the likelihood of marrying someone you can communicate with.

**Not important:** Individuals are equally likely to marry deaf and hearing individuals.

**Important:** Deaf individuals only marry deaf individuals and hearing only marry hearing.

The model shows that deaf-deaf marriages lead to a slower spread of signs through the population and lower incidences of deafness, while deaf-hearing marriages lead to a fast spread of signs throughout the population and higher incidences of deafness as a result. The latter is ironic since this is actually what genetic counselling is intended to prevent.

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