

# Semantic networks of space and time between deaf signers and Spanish hearers

Signed (International) version is available at <https://youtu.be/HSAwyUIs6I>

Roberto Aguirre, Maria Noel Macedo, Alejandro Fojo, Matías Yerro & Jorge Vivas

## Abstract

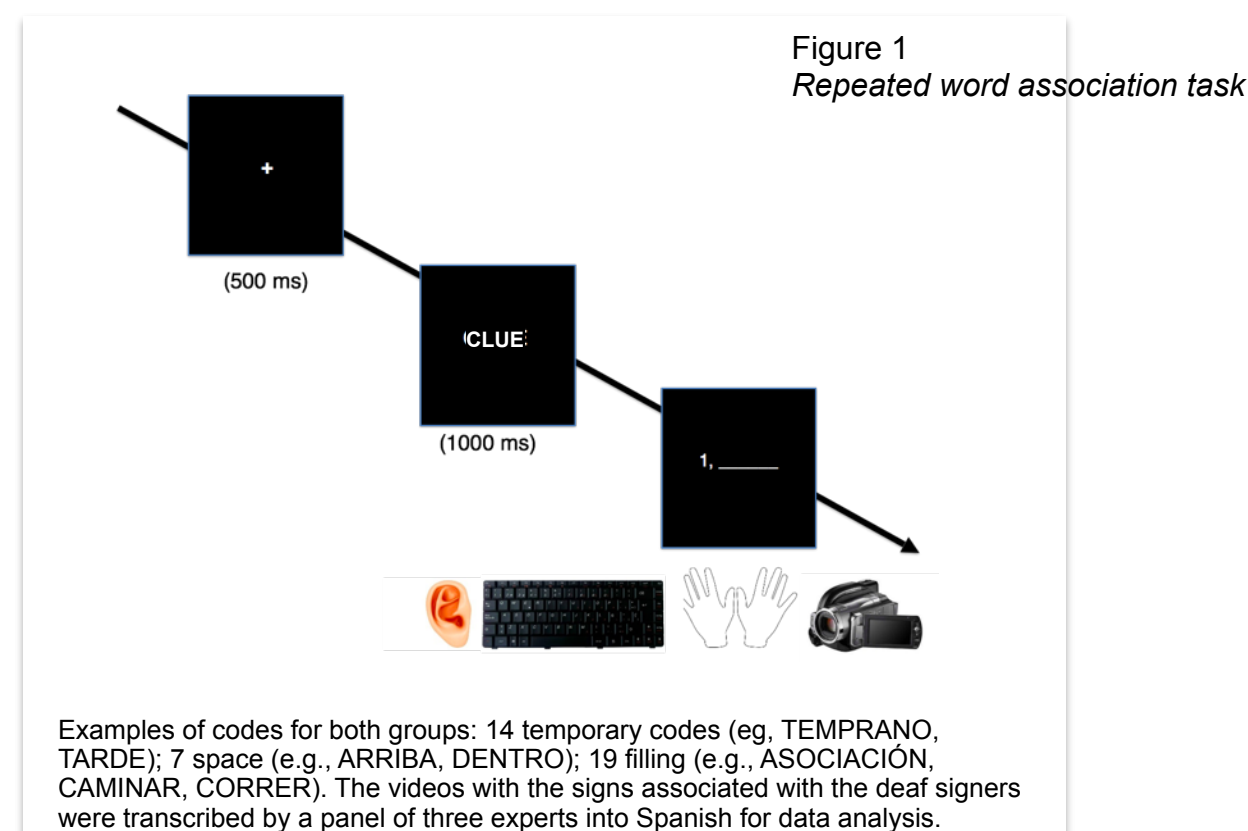
Factors such as ontogenetic development, language acquisition conditions, the development of deaf culture, conceptual domains concreteness, and the lexical repertoire available in each linguistic modality could suggest important differences in the mental lexicon of deaf and hearers. However, studies on the processing, functional, and social distribution of spoken and signed languages suggest partial overlaps between the mental lexicon of deaf and hearers. The aim of this study was to explore the semantic networks of the conceptual domains of space and time in the Uruguayan deaf signers' population and Spanish hearers. 60 participants carried out a repeated word association task in their respective languages and with semantically equivalent lexical items. Both groups matched only in the semantic network of the clue SUMMER. Mainly, a categorical-semantic analysis showed a bias of the hearers to taxonomic and introspective semantic relationships. In contrast, the deaf showed a bias toward situational semantic relationships and entities. These findings suggest differences in the concrete / abstract thinking between both populations when organizing their mental lexicon.

## Introducción

Does the language modality have any effect on the mental lexicon as a window to the formation of concepts? A fundamental question when trying to answer this question is to establish how much the linguistic, psycholinguistic and sociolinguistic differences and similarities between deaf signers and hearers can differentiate the mental lexicon of both populations. The concrete-abstract distinction of concepts offers an appropriate approach for a comparative study of the mental lexicon between linguistic modalities. Borghi et al. (2017) suggest that perceptual and action information is more relevant to concrete concepts, while emotional and linguistic information is mostly expressed by abstract concepts. In relation to the types of information referred to above in the formation of concepts, the strong sublexic iconicity of the signed languages means that the phonological pole of the signs is formed by components of the human body exposed to the interlocutors spatially (hands, torso, face, head). On the other hand, although iconicity is not absent in oral language (Dingenmanse et al., 2015), it is sustained by mostly internal components of the human body, not exposed to interlocutors (ie, larynx, tongue, alveoli, etc.) and not so ostensibly coded.

## Method

The repeated word association is a useful paradigm to describe the conceptual domains through the identification of the mental lexicon. This paradigm requires speakers of a language to produce words that come to mind after a concept presented. Then, the strength of association between the clue and the associated is measured. These are arranged in a list, starting with the most strongly associated (more times and more at the beginning mentioned). Defined as a recall task, the association provides information on semantic relationships, structuring of and between concepts and lexical labels.



## Analysis

### Semantic network analysis

Definition Finder y Synonym Finder (Vivas, 2009): measuring weights of each sign/word associated with each clue, generating a distance matrix between the clues, measuring the frequency of appearance of each associated and its order of appearance; offering normalized numerical values between 0 and 1, with 1 being the greatest weight. UCINET (Netdraw): Plotting the results, identifying groups and level of association with the entire network of words. The association levels are plotted in different force cuts of the same, with  $r = .10$  being the lowest and  $r = .90$  the highest.

### Semantic relations analysis

Adaptation of Wu & Barsalou (2009) to include concrete and abstract concepts from a grammatical typology of clues that included nouns, verbs, adjectives, and adverbs. Panel procedure: 3 experts and 3 non-experts reached a 82 % agreement in the coding of the associates (Alpha Krippendorff test).

PASADO	0.511
ADELANTE	0.2
RETROCEDER	0.111
ESPALDA	0.111
POSTERIOR	0.111
DETRAS	0.089
MIRAR	0.067
ESPERAR	0.044

	A	B	C	D
1		ABAJOS	ABAJOS	ANTES-O
2	ABAJOS	1.0	0	0
3	ABAJOS	0	0.0	0
4	ANTES-O	0	0	0.0
5	ANTES-S	0	0	0
6	ARRIBA-O	0	0	0
7	ARRIBA-S	0	0	0

## Results

**Participants:** 30 deaf signers: 19-52 years; Age ( $M$ ) = 30.8;  $SD$  = 8.8. Deaf school: Primary, 20; Secondary, 12. Deaf family: Yes, 19; No, 13. Deaf from birth: Yes, 24; No, 8. Current schooling: Secondary, 18; Tertiary, 12. 32 Spanish hearers: 18-50 years; Age ( $M$ ) = 33.1;  $SD$  = 9.8. Current schooling: Secondary, 18; Tertiary, 12

Figure 2

Visualization of the similarities and differences between the semantic networks of deaf signers and hearers ( $r = .0$ ,  $r = .50$ ,  $r = .80$ )

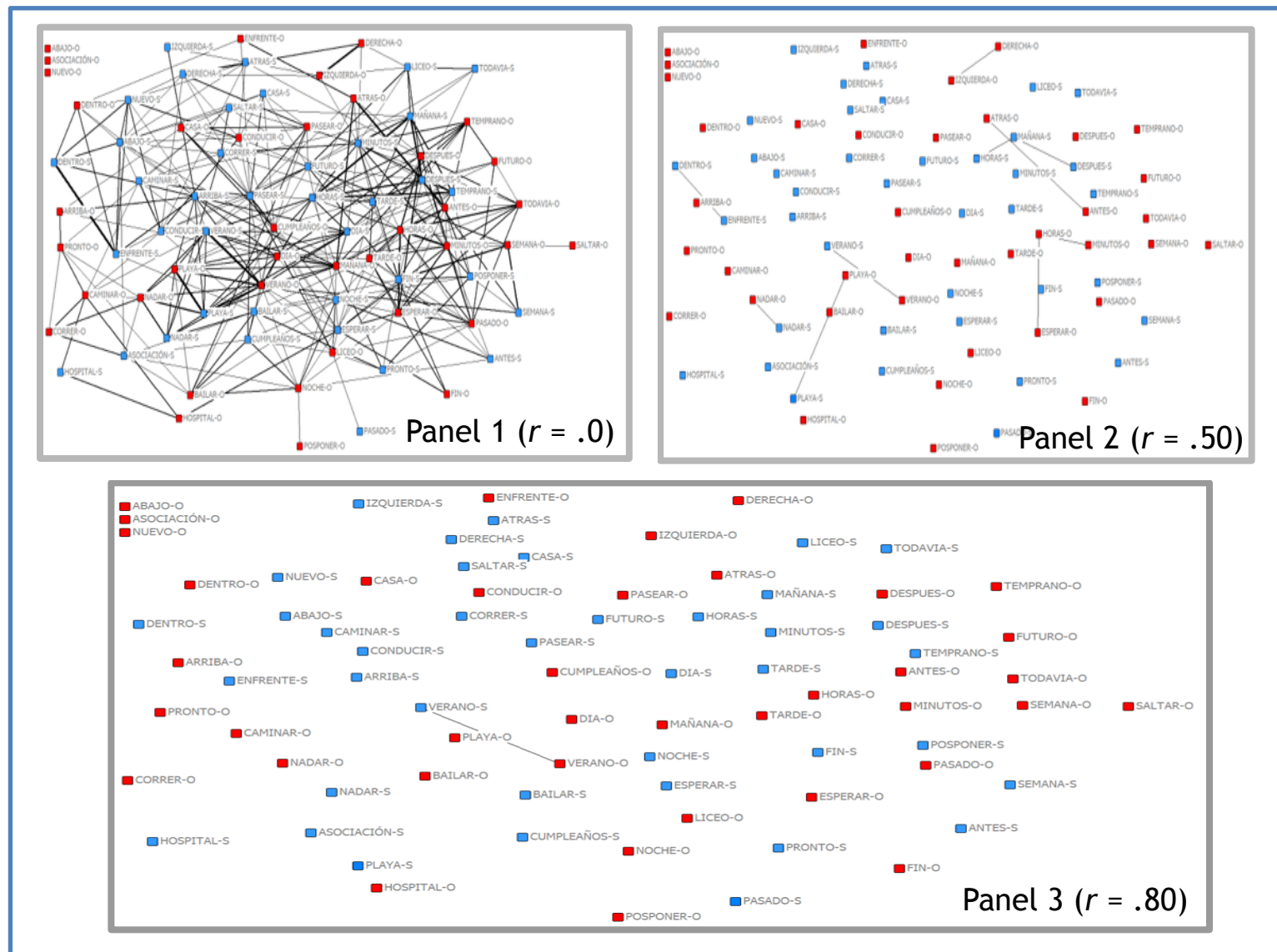


Table 1

Comparative visualization of deaf and hearers semantic network descriptors

Group	Network descriptors				
	Freeman Degree Centrality	Betweenness	Small World Index	Density	Clustering Coefficient
Deaf	.062	2,92	2,48	23,97	69,53
Speakers	.072	3,41	3,77	19,08	89,27

Quadratic Assignment Procedure was used for comparing the dyad between groups data set. Pearson correlation showed  $r(60) = .16$ ,  $p = .002$

Table 2

Test of proportion for two independent populations (deaf signers vs hearers)

Type	Deaf signers		Spanish hearers		p(value)
	Cases	p	Cases	p	
Taxonomy	24	.064	63	234	<.001
Entity	98	.344	73	265	.057
Introspective	46	.143	53	215	.036
Situation	110	.488	77	284	<.001
Total	278	1	266	1	....

## Conclusions

- Strong semantic between groups network differences: only for the VERANO (SUMMER) clue there is a high similarity (Figure 2, panel 3). Pearson Correlation in QAP test show significant differences in the structure of deaf vs hearers semantic networks (Table 1).
- The results of the semantic relations analysis (Table 2) suggest a bias for taxonomic semantic relationships and introspective semantic relationships in hearers. On the other hand, deaf signers would present a bias due to situational and entity semantic relationships.
- A more detailed analysis of the data will allow us to weigh the scope of the differences and similarities (for example, grammatical type of the associates variations per group, absence of semantic equality sign = word, or reuse of associated between clues) between the semantic networks of both groups and interpret their meaning for the description of semantic memory.

## Affiliation and contact information

Matías Yerro and Jorge Vivas are researchers at the Instituto de Psicología Básica, Aplicada y Desarrollo de Tecnología, Psicológica Mar del Plata, Argentina.

Roberto Aguirre, Alejandro Fojo, and María Noel Macedo are researchers at the Centro de Investigación Básica en Psicología. Montevideo. Uruguay. Contact: marianoelmacedo@gmail.com



Grant number: ANII\_FCE\_3\_2016\_1\_127048

## References

- Borghi, A. M., Binkofski, F., Castelfranchi, C., Cimatti, F., Scorolli, C., & Tummolini, L. (2017). The challenge of abstract concepts. *Psychological Bulletin*, 143(3), 263.
- Dingenmanse, M., Blasi, D. E., Lupyan, G., Christiansen, M. H., & Monaghan, P. (2015). Arbitrariness, iconicity, and systematicity in language. *Trends in cognitive sciences*, 19(10), 603-615.
- Vivas, J. (comp.). (2009). Evaluación de redes semánticas: instrumentos y aplicaciones. Mar del Plata: EUDEM
- Wu, L. L., & Barsalou, L. W. (2009). Perceptual simulation in conceptual combination: Evidence from property generation. *Acta psychologica*, 132(2), 173-189.