Contrasting the semantic typology biases of Deaf and hearers in their conceptualization of time and space

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1 Introduction

In what aspects could the linguistic modality modulate the organization of concepts in the human mind? The results of free association tasks of Marschark et al. [1] and Mann et al. [2] suggest that language development in signed and spoken languages is driven by similar learning mechanisms rooted in the development of semantic networks. Factors such as familiarity, phonological neighborhood, and frequency of lexical items are equally relevant factors with essential similarities in the processing of spoken and signed languages [3]. Furthermore, despite different experiences in formal and informal lexical learning, deaf and hearer's development shows similar trends. Signs are better than words at iconically representing the concepts they denote [4]. Various ways of relating concepts represent semantic knowledge: taxonomic relations predominantly activate a process of comparison between objects, while thematic relations activate a process of integration. Borghi et al. [5] suggest perceptually, and action information is more relevant to concrete concepts, while abstract concepts mainly express emotional and linguistic knowledge. Notably, as in the research with hearer populations, space and time are domains considered as concrete the former and abstract the latter [6] we understand that for concrete domains the entity and situational relations might be more common, and, for the abstract domains, the taxonomic and introspective relations might be the more common. However, a cross-modality approach has been scarcely tested. We do it in this study.

2 Method and data analysis strategy

Sixty-two participants (30 deaf and 32 hearers, matched in age (M = 30, SD = 8,8) and education (Secondary, 36; Undergraduate, 24) carried out a repeated word association task with dual-class pieces in a concurrent domain clue format (i.e., open-class pieces such as Minutos "minutes" and near closed-class dichotomic pairs such as Dentro vs. Fuera [In vs. Out]) in their respective languages and with semantically equivalent lexical items. There were 39 semantic matched signs/words used as clues (e.g., Spanish words such as Pasado "past" fit with the sign "past"). A digital video camera recorded

the Deaf participants when signing three associated signs which come to mind after seeing a clue. For Spanish participants, Spanish clues were displayed on the screen. Then, Spanish participants typed their responses on the keyboard. The response of deaf participants was translated into Spanish. We adapted the unification criteria proposed by McRae et al. [7] to deal with the variability of the responses. For analyzing the semantic network, we express the results with normalized numerical values, generating a square matrix of distance, a similarity matrix, and a square-1 matrix mode. Definition Finder [8], Synonym Finder [9], and Johnson method [10] were used. For semantic categories analysis, we adapted the coding created by Wu and Barsalou [11] and Barsalou and Wiemer-Hastings [12]. There were four analyses of the level of inter-judge agreement. With all judges, Krippendorff's alpha returned a value of .82. This value is considered an acceptable level of inter-judge understanding.

3 Results

The Quadratic Assignment Procedure (QAP) was used to compare the general structure of the semantic networks between both linguistic modalities. Pearson's correlation shows a minimal correlation between both networks (.216). A Mann-Whitney Test showed no significant differences in entropy between the groups. The score of the Deaf (Mean rank = 41.42, Min = .87, Max = .99) was not higher than that of the hearers (Mean rank= 37.58, Min = .85, Max = .98), U = 685.5, p = .454. The Chi-squared test of the coding carried out by the judging procedure showed significant differences between the two groups (deaf and hearers) concerning the chosen semantic categories ($X^2(3, N = 62) = 336.40$, $p < .001$). However, only for taxonomic relations, do the residuals show a score greater than 2 (5.9 for deaf and 6.09 for hearers). Figure 1 shows the results of clustering and semantic category.

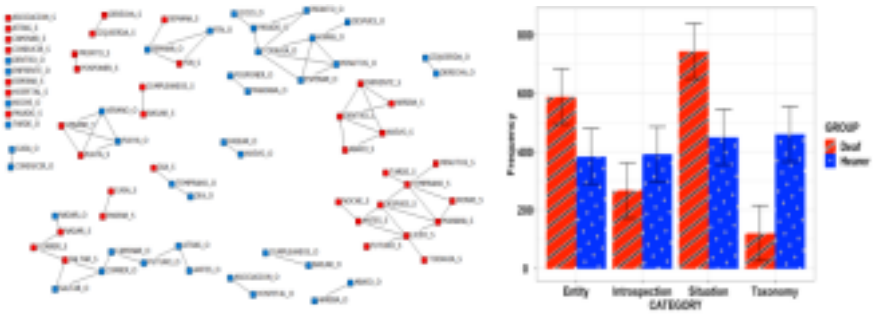

Figure 1
Left image: Cluster representation of the cosine similarity matrix, cut at r = .14
Right image: Distribution of responses by semantic category by group (error bars show the Standard Error of the Mean)

4 Discussion

This research was conducted to answer the question of how similar the conceptual organization of space and time domains between deaf and hearing populations is. The results indicate that the mental lexicon between the two populations (deaf and hearers) differed significantly in several aspects: i) a strong differentiation of clusters per group, but most of them were limited by the domain (time or space); ii) a more robust inclusion of concepts (clues) in the clusters for the hearing group concerning the deaf group, iii) non between domain differences for the distribution of the lexical-semantic relations preferred by each population, and iv) greater significant availability for the

lexical semantics of taxonomic relations for hearers. We understand the latter as an index of more abstract thought in hearing than in the Deaf population. The main limitation of the study was that the sample was small. It might be expected that the larger the sample, the more the semantic networks of both groups will converge.

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