# Do we see the same thing? Perception of phonemic contrasts in sign languages

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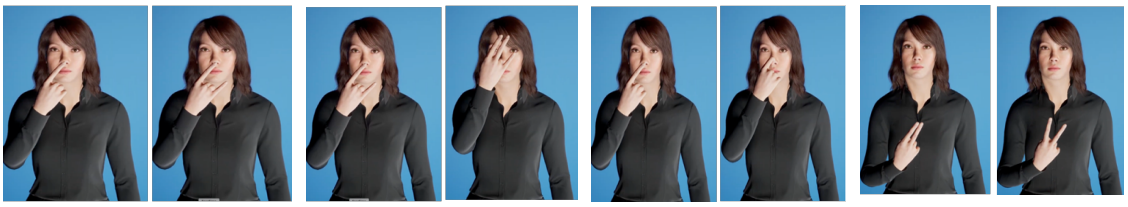
Perceptual Categorization (PC) of phonemic contrasts has been studied in only a few sign languages (see Baker et al., 2005, Best et al., 2010, and Emmorey et al., 2003 for American Sign Language; Gimeno-Martínez et al., 2020 for Catalan Sign Language; Mertz, 2022 for French Sign Language). These studies show mixed results and are limited by types of stimuli used (e.g. still images, disembodied hands or unnatural-looking synthesized signs). Our study aims at examining PC of phonemic contrasts in users of Catalan Sign Language (LSC), Spanish Sign Language (LSE) and Sign Language of the Netherlands (NGT). We use realistic avatars signing four handshape contrasts that involve changes in selected fingers (fig. 1A-B) or in finger position (curving and spreading of the fingers) (fig. 1C-D). We explore whether differences in categorization depend on the type of phonological feature. The contrasts of our study include existing and non-existing feature values (handshapes) in the phonological repertoire of the sign languages to examine the role of linguistic knowledge in the perception of categories. We test signers and non-signers to explore the impact of familiarity with the visual modality.

We present pseudosigns as name signs of members of a family. Stimuli were recorded by a signer using motion capture and then synthesized on a MetaHuman avatar. For each contrast, we created a set of eight stimuli equally distributed between the two target signs (fig. 2). Participants performed an ABX (categorization) task and a same-different (discrimination) task in two orders (ABX-BAX, AB-BA). For each contrast, the ABX task has 64 trials (8 contrast variants x 4 repetitions x 2 orders), and the same-different task 96 (6 contrast variants x 4 repetitions x 2 conditions (same-different) x 2 orders).

Plots of the proportion of responses from LSC and LSE signers, and non-signers for each variant pair show that the degree of PC depends on contrast type. For changes in selected fingers between existing handshapes, the classic PC pattern is found for signers: a steep slope in the ABX categorization task marks a clear boundary of the category, and high accuracy when discriminating at the boundary in the same-different discrimination task. Non-signers seem to have more variability in the location of the boundary (fig. 3). By contrast, when the addition of a selected finger results in a non-existing handshape, the pattern is random across participants: less clear boundary in the ABX task and no clear pattern discriminating within or between categories (fig. 4). Changes in finger position (curving) show less degree of PC with a less steep slope in the results from the ABX (categorization) task and no consistent responses in the discrimination task (fig. 5). Changes in finger position (spreading) seems to be contrastive between +/- contact between fingers, since in both tasks the boundary is consistently found in variants where the fingers lose contact (fig. 6). Therefore, category seems to be dependent on the prominence of anatomical features that serve as reference points. Similar patterns and category boundaries are found in the three groups: LSC and LSE signers and non-signers, which indicates that categorization of these contrasts might not be driven by linguistic knowledge but is driven probably by a more general visual-domain classification of the human body.

Data of NGT signers will be collected in September and we will carry out mixed-effect linear models to examine the impact of variant type, sign language knowledge and sign language. Results will be ready for the workshop. So far, the findings reveal that the degree of PC in the visual linguistic domain depends on the prominence of anatomical features and does not appear to be linked to language experience. This work contributes to a better understanding of the role of modality in grammar by showing that the categorization of different types of phonological contrasts depends on the type of visual features: some features are perceived and categorized in a binary way while others show more gradient values. All in all, this research contributes to understanding better the cognitive mechanisms underlying the perception of phonological contrasts in sign languages and paves the way to investigating how linguistic categories are represented in the brain.



A. Addition of a selected finger (existing hs) | B. Addition of a selected finger (non-existing hs) | C. Change of finger position (curving) | D. Change of finger position (spreading)

**Figure 1. Contrasts examined in the study.**

A B

**Figure 2. Continuum for the contrast with change of finger position (spreading)**

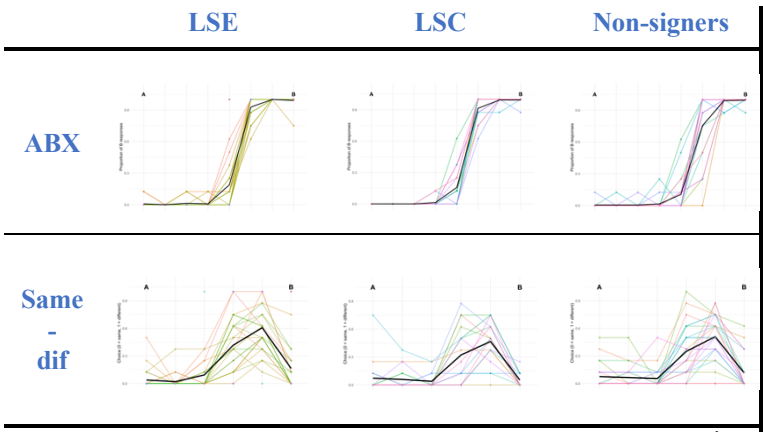



**Figure 3. Addition of a selected finger (existing hs)**[i]

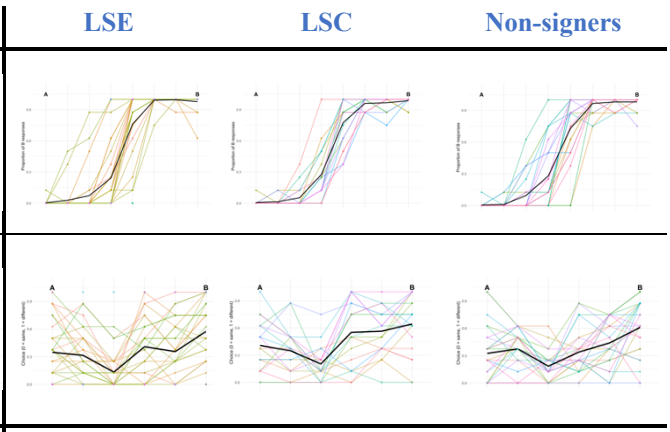



**Figure 4 Addition of a selected finger (non-existing hs)**

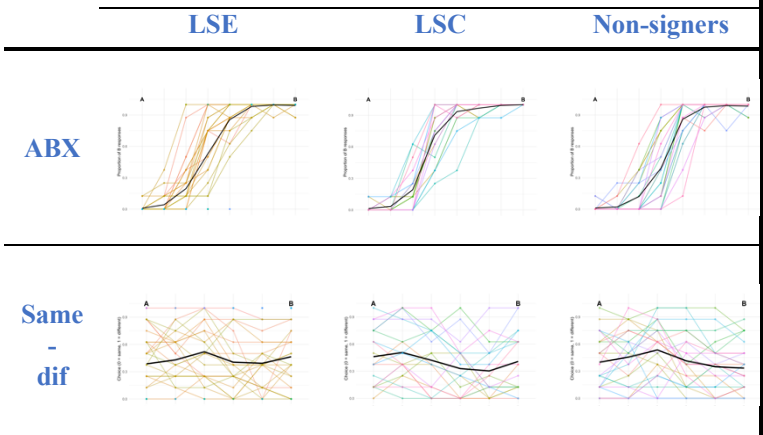



**Figure 5. Change of finger position (curving)**

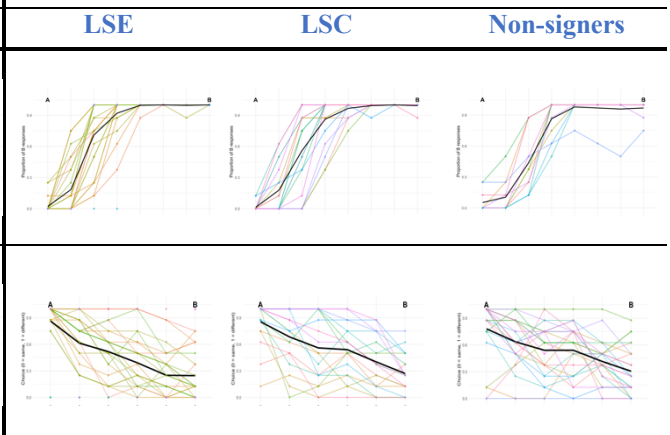



**Figure 6. Change of finger position (spreading)**

**Selected references**

[1] Baker, S.A. et al. (2005). The perception of handshapes in American sign language. *Memory & Cognition*, 33(5), 887–904. [2] Best et al. (2010). Effects of sign language experience on categorical perception of dynamic ASL pseudosigns. *Attention, Perception & Psychophysics*, 72(3), 747–62. [3] Emmorey, K. et al. (2003). Categorical perception in American Sign Language. *Language and Cognitive Processes*, 18 (1), 21–45. Psychology Press Ltd. [4] Gimeno-Martínez, M. et al. (2020). Influence of Gesture and Linguistic Experience on Sign Perception. *Journal of Deaf Studies and Deaf Education*, 25(1), 80-90. [5] Mertz, J. (2022). *Phonological contrast and feature inventories in sign language: a study on French Sign Language (LSF)* [PhD thesis]. Université Paris Cité.

[i] In all plots of the ABX task the *y* axis indicates the proportion of B responses and the *x* axis the variants of the continuum for each contrast. In the same-different task the *y* axis refers to the choice of the participants (0 = same, 1 = different) and the *x* axis refers to the variant pairs that were shown from the continuum.