Coverage Constraints in Conceptual Property Norms: Comparisons Between Congenitally Blind and Sighted individual reveals differential cognitive processing

Rodrigo Lagos[1], Felipe Toro-Hernández[2], Enrique Canesa[1,3], Sergio Chaigneau[1]

[1]Center for Social and Cognitive Neuroscience (CSCN), Adolfo Ibañez University
[2]Center of Mathematics, Computation and Cognition (CMCC) Federal University of ABC (UFABC)
[3]Faculty of Engineering and Science, Adolfo Ibañez University

Introduction

Concepts are essential cognitive units, supporting categorization, inference, and communication. Theories of grounded cognition propose that conceptual representations partially rely on the reactivation of sensory–motor experiences, suggesting that concrete concepts—especially those with strong visual components—are neurally grounded in perceptual systems. Comparing congenitally blind and sighted individuals offers a natural experiment to examine how the absence of visual experience impacts conceptual representations. In blind individuals, concrete concepts with visual salience may be learned via social and educational channels, resembling the acquisition of abstract concepts. This has implications for understanding both conceptual development and brain organization.

The Property Listing Task (PLT) is a widely used method to access semantic content by collecting features associated with each concept. However, PLT data typically follow long-tailed distributions, making raw feature counts and equal sample sizes unreliable for group comparisons.

To overcome this, we adopt the non-parametric Chao2BC estimator, originally developed in ecology, which accounts for unseen features and provides confidence intervals. A key metric in this framework is sample coverage, estimating the proportion of the true feature set that has been observed. High coverage (typically ≥0.70) is required for reliable comparisons.

In this study, we analyze a validated dataset (the BLIND corpus), comparing the semantic richness of concrete concepts in blind and sighted adults. We show that filtering by coverage affects both the stability and interpretability of results—highlighting the importance of sampling strategies that ensure robust estimation of semantic content across groups.

Methods

We analyzed the BLIND corpus, a set of conceptual property norms collected from congenitally blind and sighted Italian participants, using the asymptotic conficence interval Chao2BC estimator to quantify semantic richness for each concept. In this dataset, participants had to name as many items as possible for any given concept. Without coverage filtering, most concepts produced unstable estimates with wide confidence intervals.

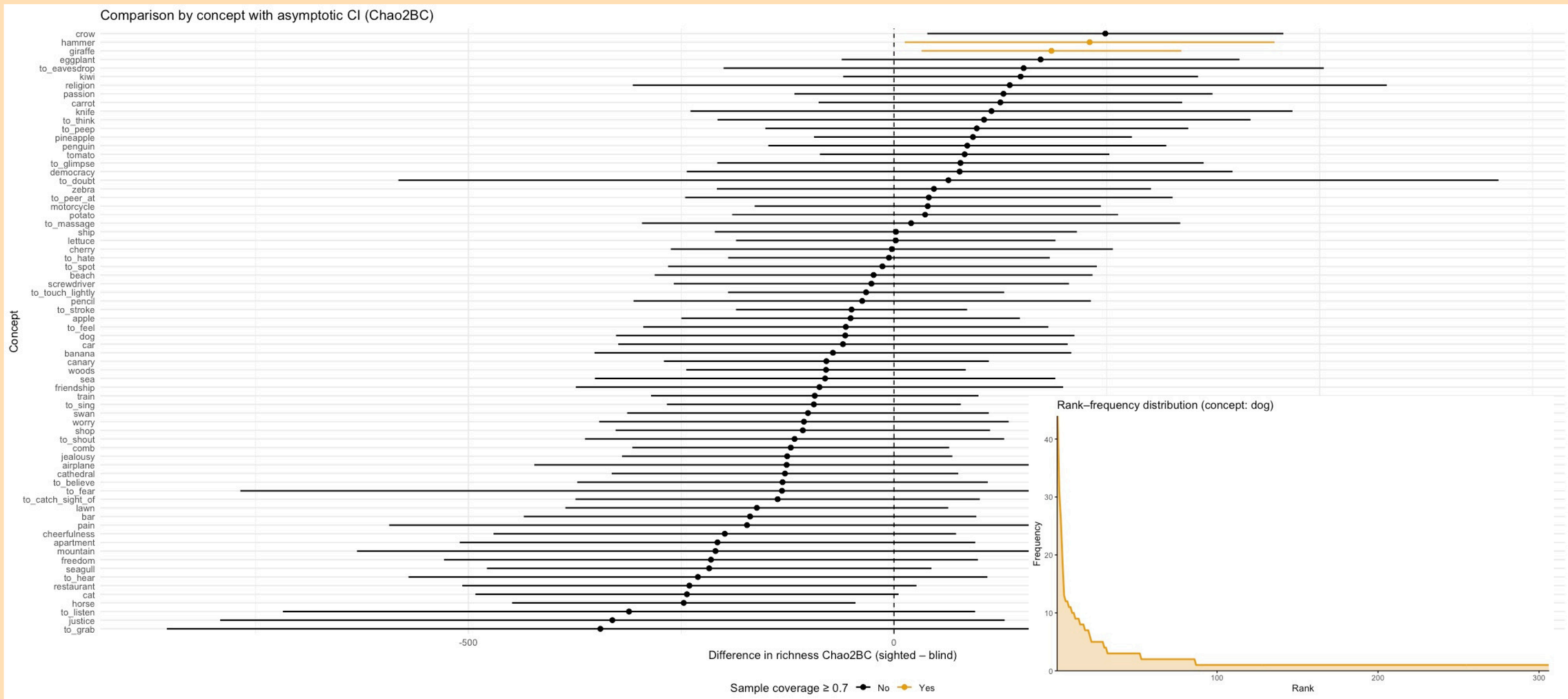
$$\widehat{C(T)} = 1 - \frac{Q_1}{U}\left[\frac{Q_1(T-1)}{Q_1(T-1)+2Q_2}\right]$$

$$\widehat{Chao2BC} = S_{obs} + A\frac{Q_1(Q_1-1)}{2(Q_2+1)}$$

Results

Applying a ≥0.70 coverage threshold improved precision but reduced the dataset to only two concrete concepts—both showing significant group differences. Although these results are consistent with expected patterns, the limited number of analyzable concepts precludes strong conclusions. Thus, we recommend taking into account coverage when performing a PLT study and getting a minimum coverage of 0.70 for all the concepts.

PLOTS



Discussion

To ensure reliable group comparisons in property listing data, sample coverage should reach at least 0.70 and remain balanced across conditions. Without this, confidence intervals become unstable and observed differences may reflect sampling artifacts rather than true cognitive variation. We recommend that conceptual norming studies explicitly standardize coverage thresholds during design and analysis to support valid inferences.

References

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