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Linguistic representations of objects make use of external representations, shared between human and non-human animals, whose format is numerical.

Object Representations and Their Relation to Negative Shapes: Implications for Numerical Cognition and Its Apparent Evolution

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INTRODUCTION

- Language is a window on **core knowledge** and **active representation**
- **Core knowledge** is mainly perceptual
- **Active representation** involves reasoning on objects

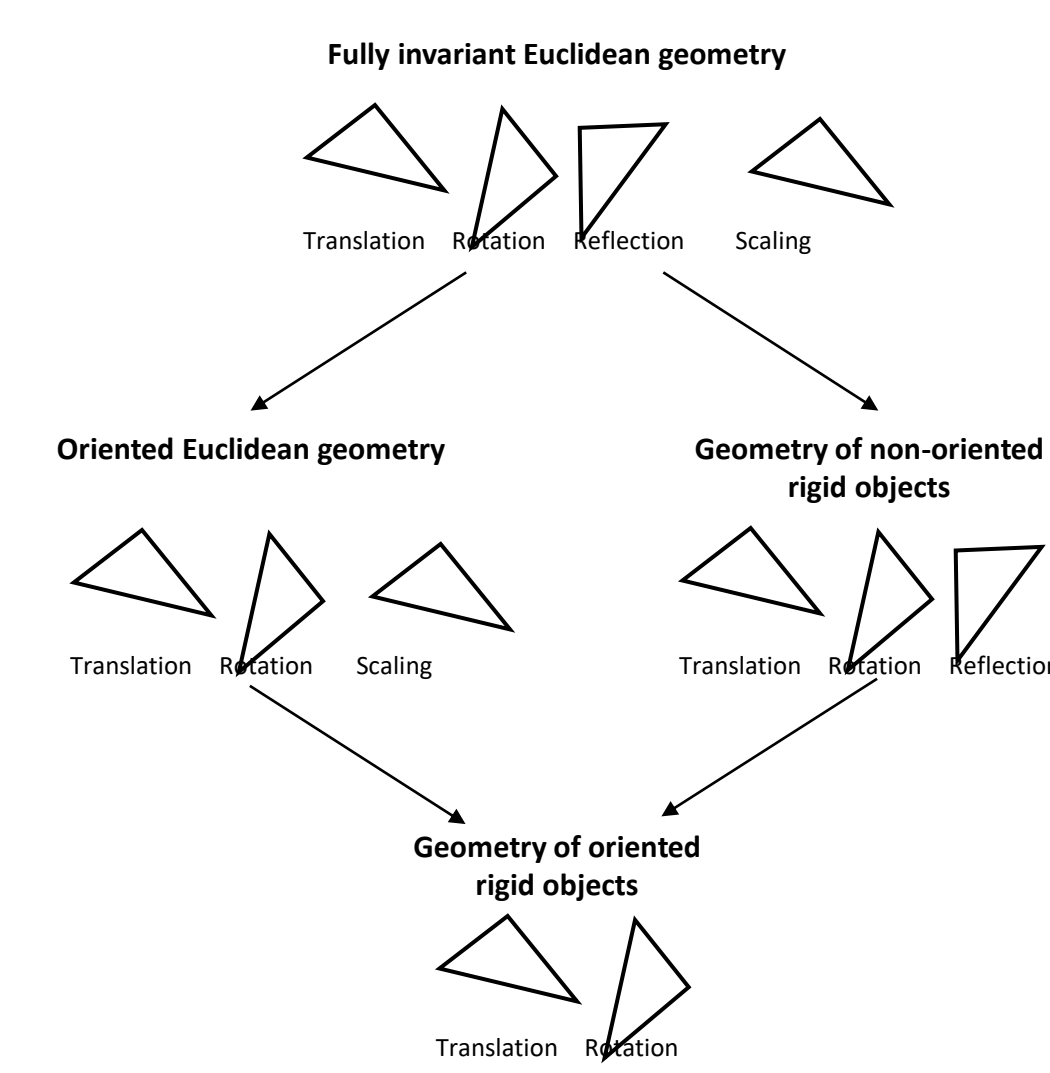
CONTRIBUTION

- In language, **classifiers** express both systems
- One type of classifiers expresses **underspecified shapes** with an independent existence (e.g. an empty round volume that can be filled)
- Another type of classifiers expresses shapes that are **imperfect images** of other objects, that can be more or less complete (e.g. a shadow)
- Both types can be **mapped to quantities**, either by considering the volume of the shape, or the degree of verisimilitude of the image with respect to the original
- Classifiers also provide information on **transformations** of shapes, that is part of active representation

- The two types of classifiers seem to correspond to the **two types of geometries**, identified by (Izard, Pica, and Spelke, submitted)
- One geometry deals with **non-rigid objects**, the other deals with **rigid ones**
- Objects treated by the two geometries are **not divided as simply as we would expect**
- However, **existing division hints at fundamental properties** of core knowledge and active representation

CONCLUSIONS

- **Representations in core knowledge are numerical** (quantitative) in nature
- Language makes use of this representation as the **Language of Thought**
- Following this idea, **language** does not seem to be the product of evolution, but rather the **reorganization of ancient computational systems in the brain**
- Our analysis should be compared against Spelke's leading idea, that language always transforms core knowledge



From (Izard, Pica and Spelke, submitted)

- Example: *-bi* in *bôg-bi* 'wrist' / 'handful'; it expresses an underspecified shape or volume, that is round when it is filled
- Example: *-biog-buk* in *taperadup-biogbuk* 'photocopy'; it express the imperfect image of an object, with its own life (like a shadow)
- Example: liquids are not all part of the same classifier type. *-di* is related to water, and treated as a non-rigid object; *-doy* is related to blood, and interpreted as an imperfect image
- *Water's* shape is defined by the way it falls (geometrical transformation that can be applied to it)
- *Blood's* shape is defined by its viscosity/transparency, interpreted as a degree of verisimilitude

References

Izard, V., Pica, P., Spelke E. (Submitted). *Perceptual foundations of Euclidean Geometry*
Izard, V., Pica, P., Dehaene, S., Hinchey, D., & Spelke, E. (2011). *Geometry as a universal mental construction*. In Space, Time and Number in the Brain (pp. 319-332). Academic Press.



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