

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

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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

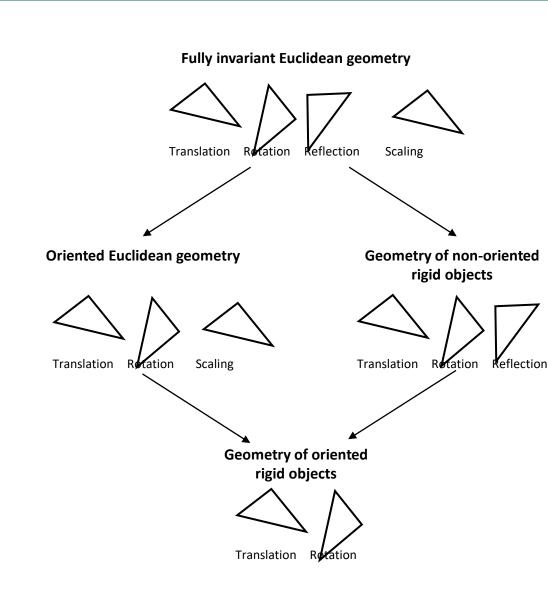
# CONTRIBUTION

- 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 taperadupbiogpuk '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

zard, V., Pica, P., Spelke E. (Submitted). *Perceptual foundations of Euclidean Geometry* zard, 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.









