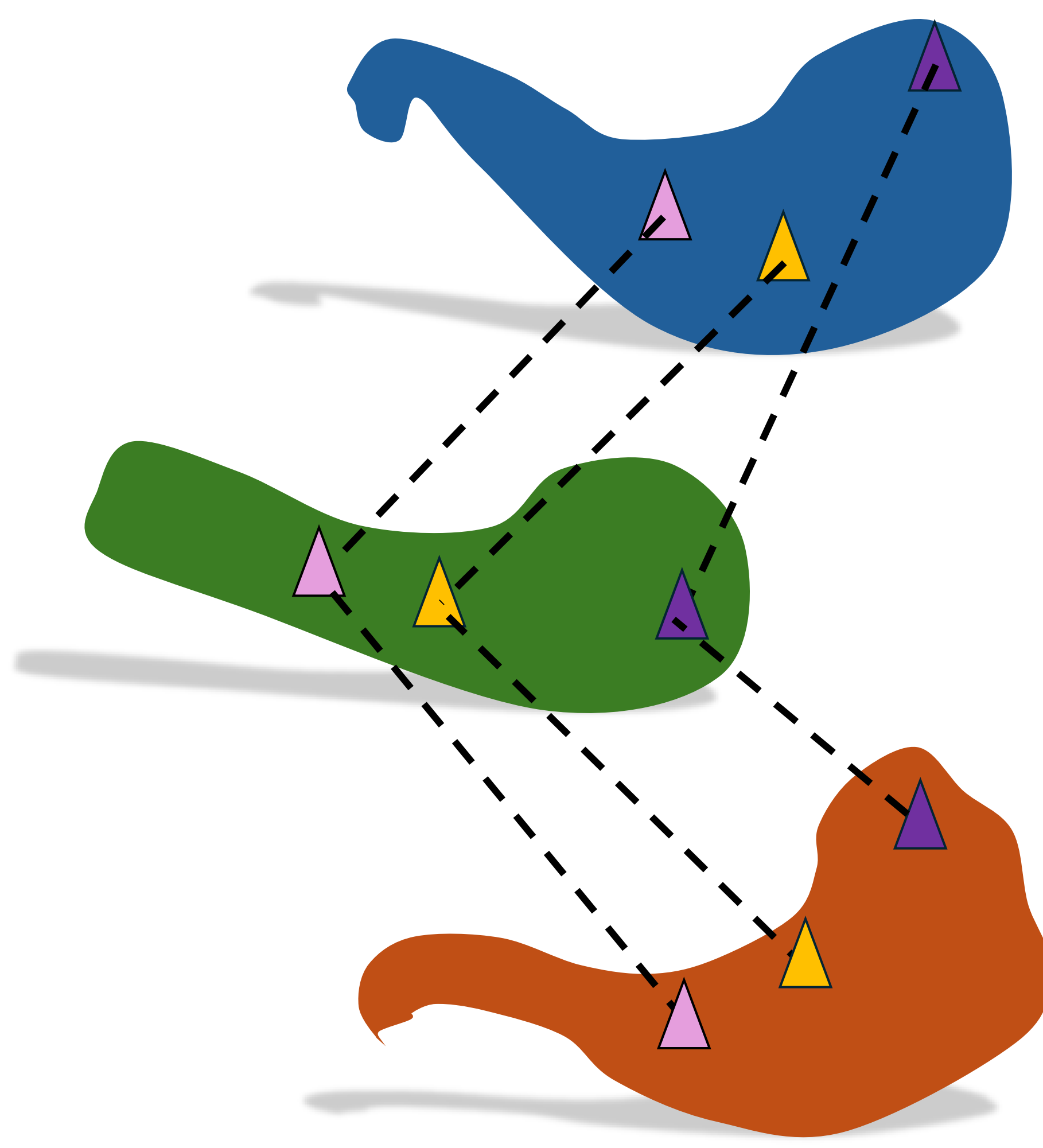


The Representational Geometry of Number



Zhimin Hu

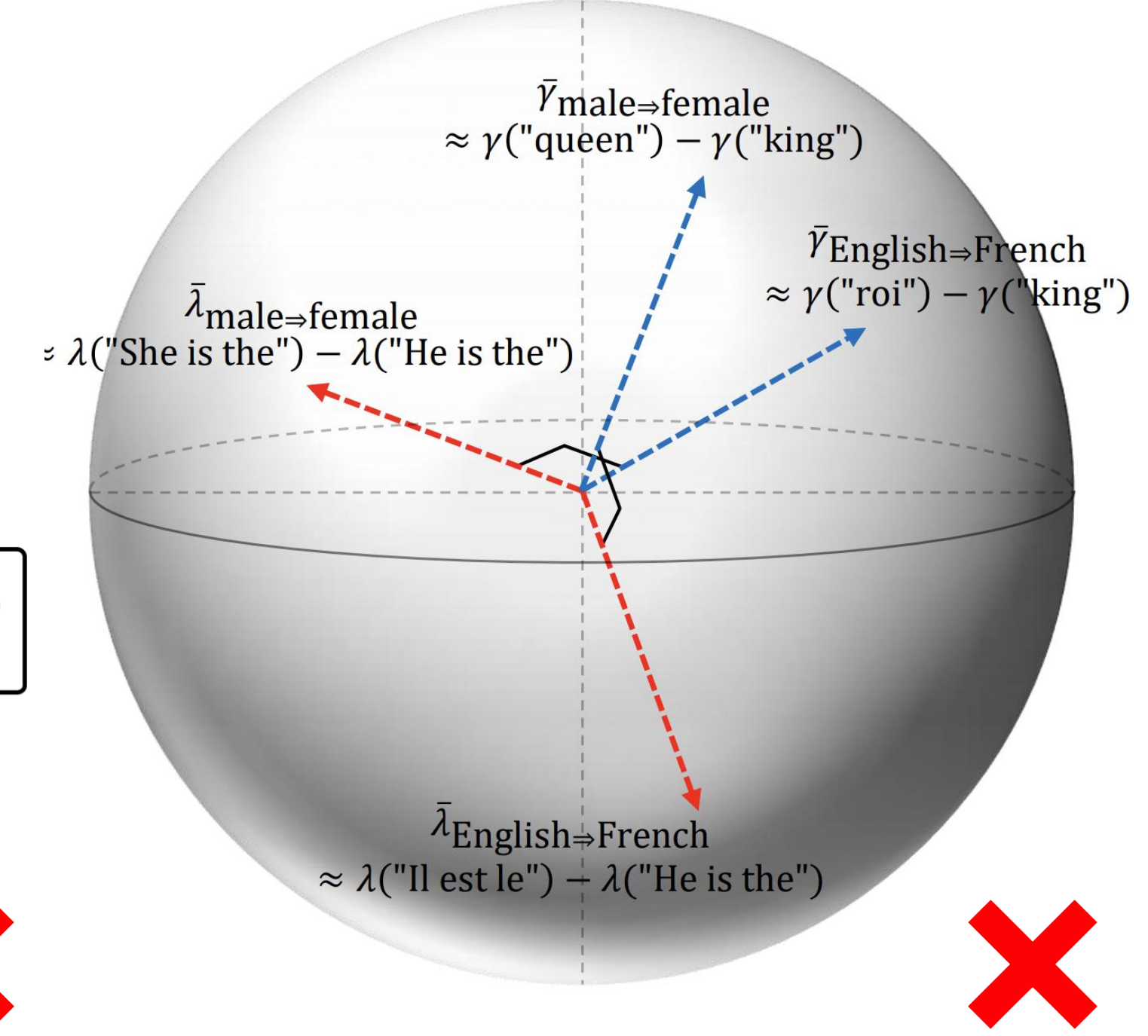
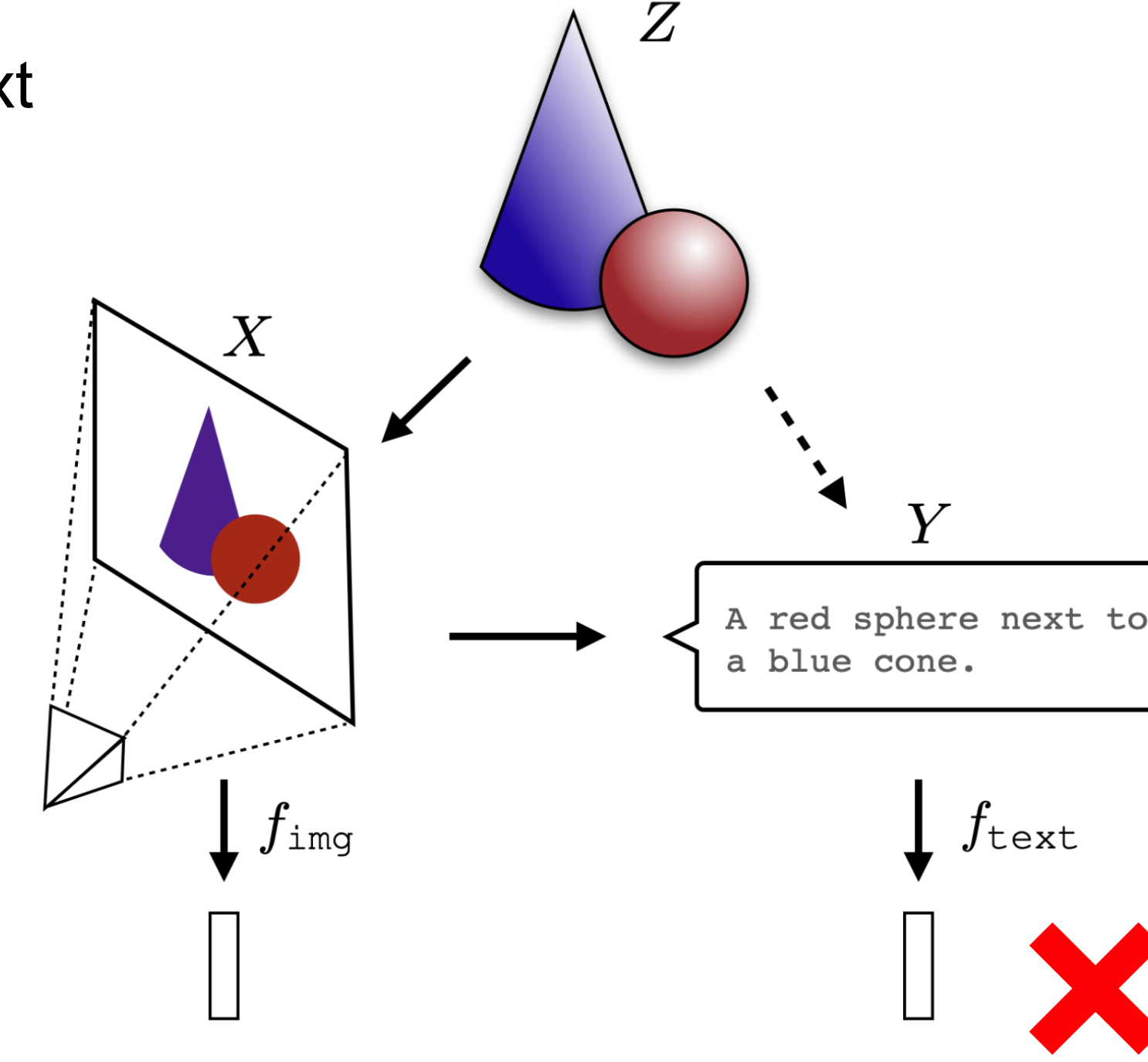
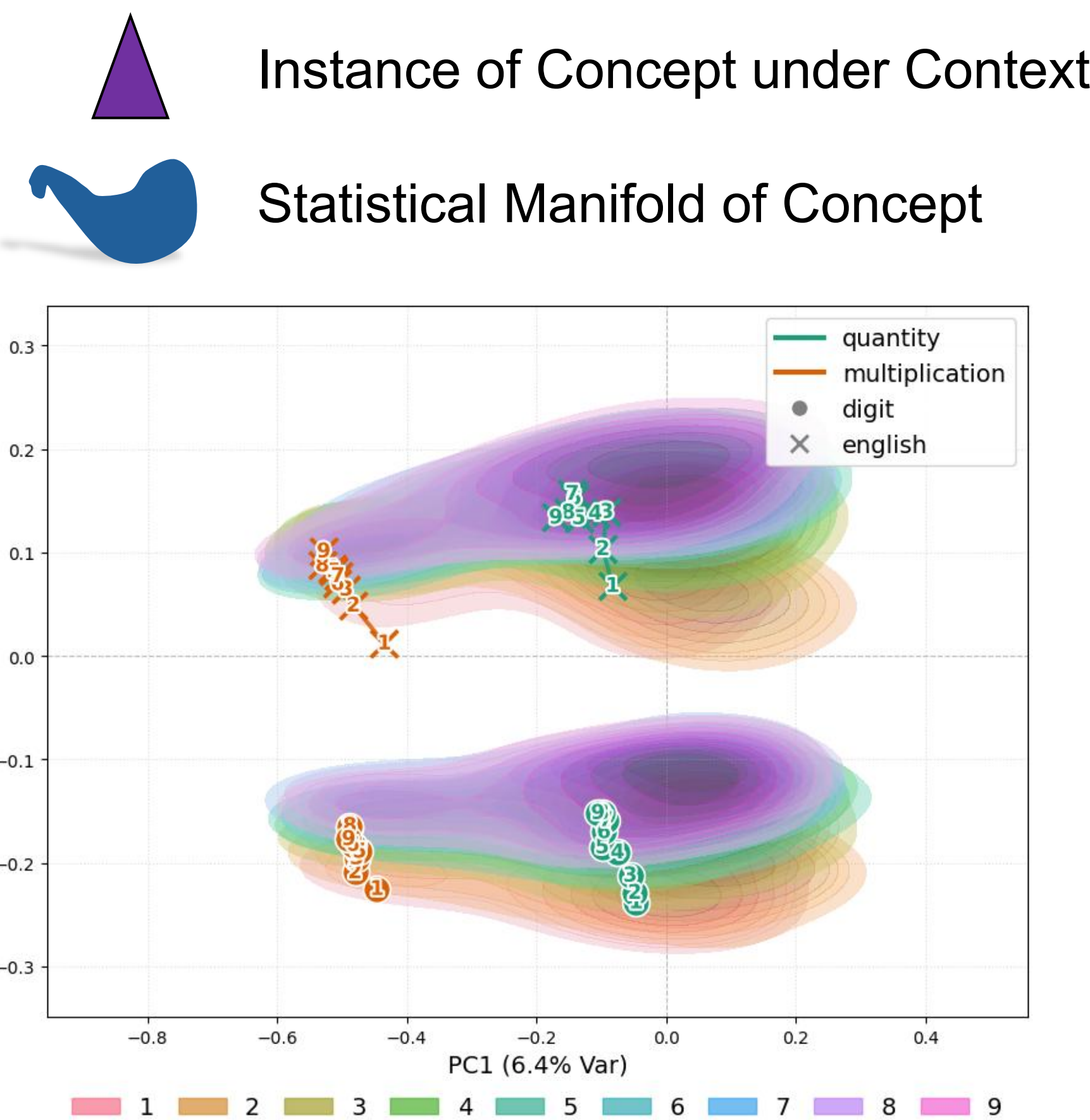
Georgia Tech

Lanhao Niu

Edinburgh

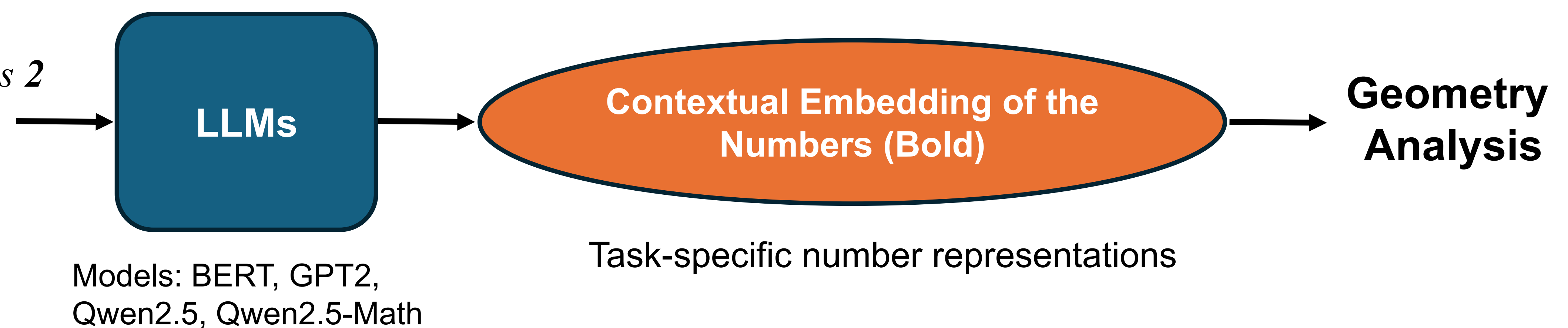
Sashank Varma

Georgia Tech

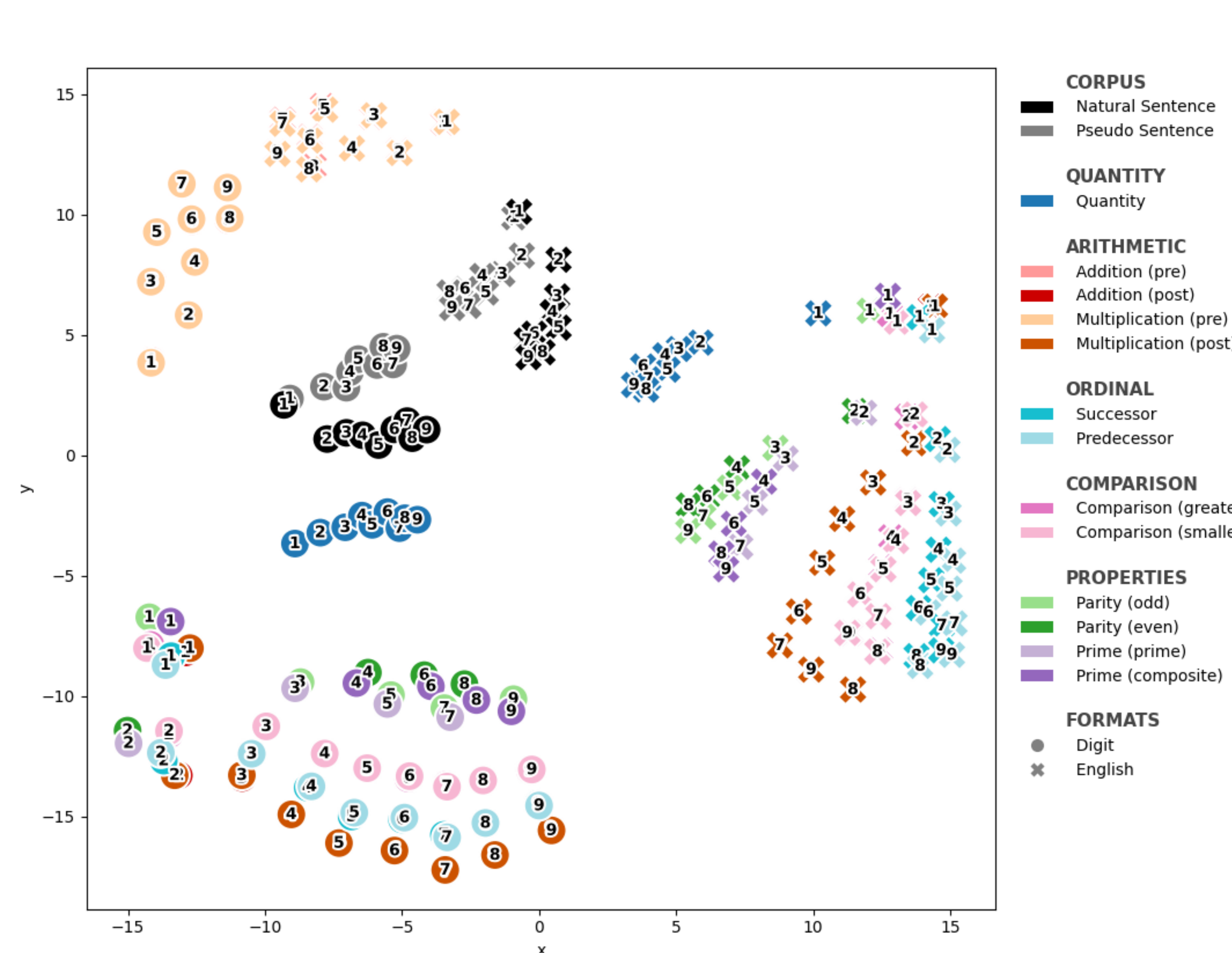


Representational sharing lies not in the concepts themselves, but in the geometric relations between them. Task subspaces of these relations are largely transformable into one another via linear mappings, despite being located in distinct subspaces.

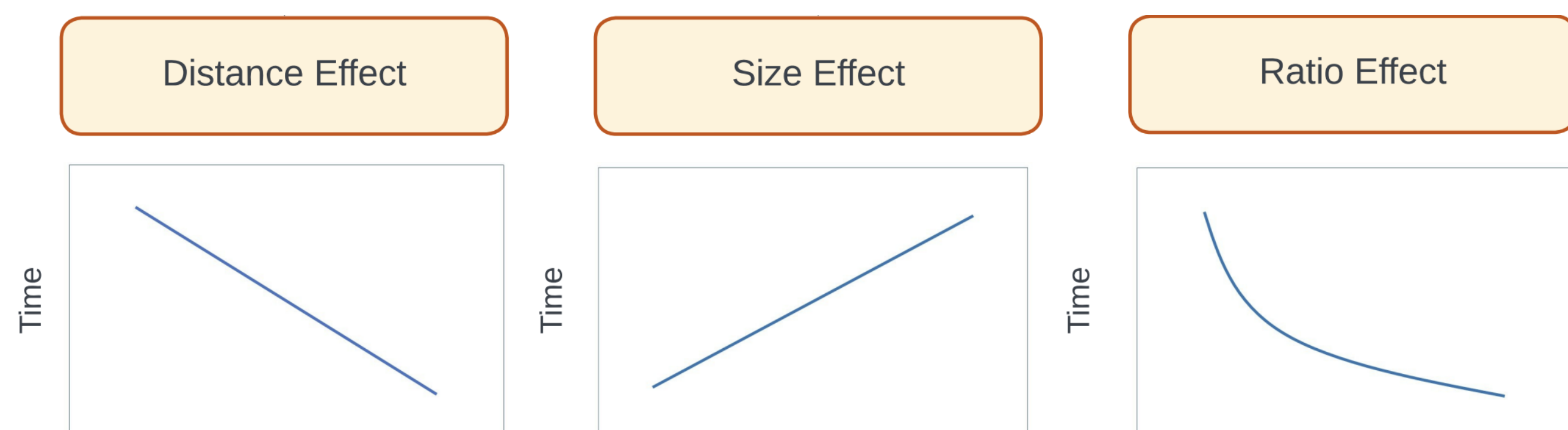
Methods

Quantity: *I have 4 apples*Compare: *The number greater than 1 is 2*Addition: *The sum of 0 and 1 is 1*Parity: *The odd numbers include 1*Successor: *The number after 1 is 2*

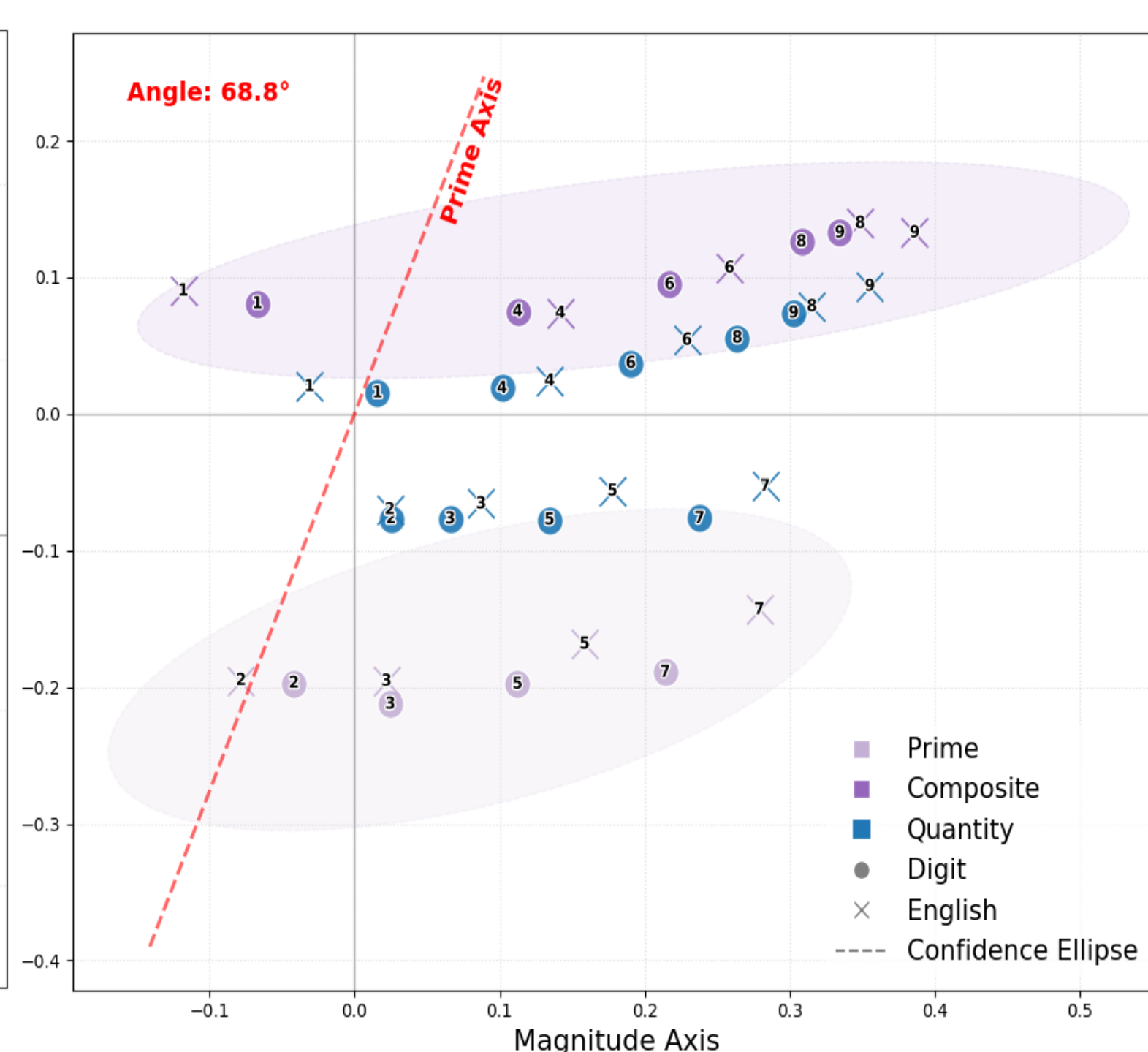
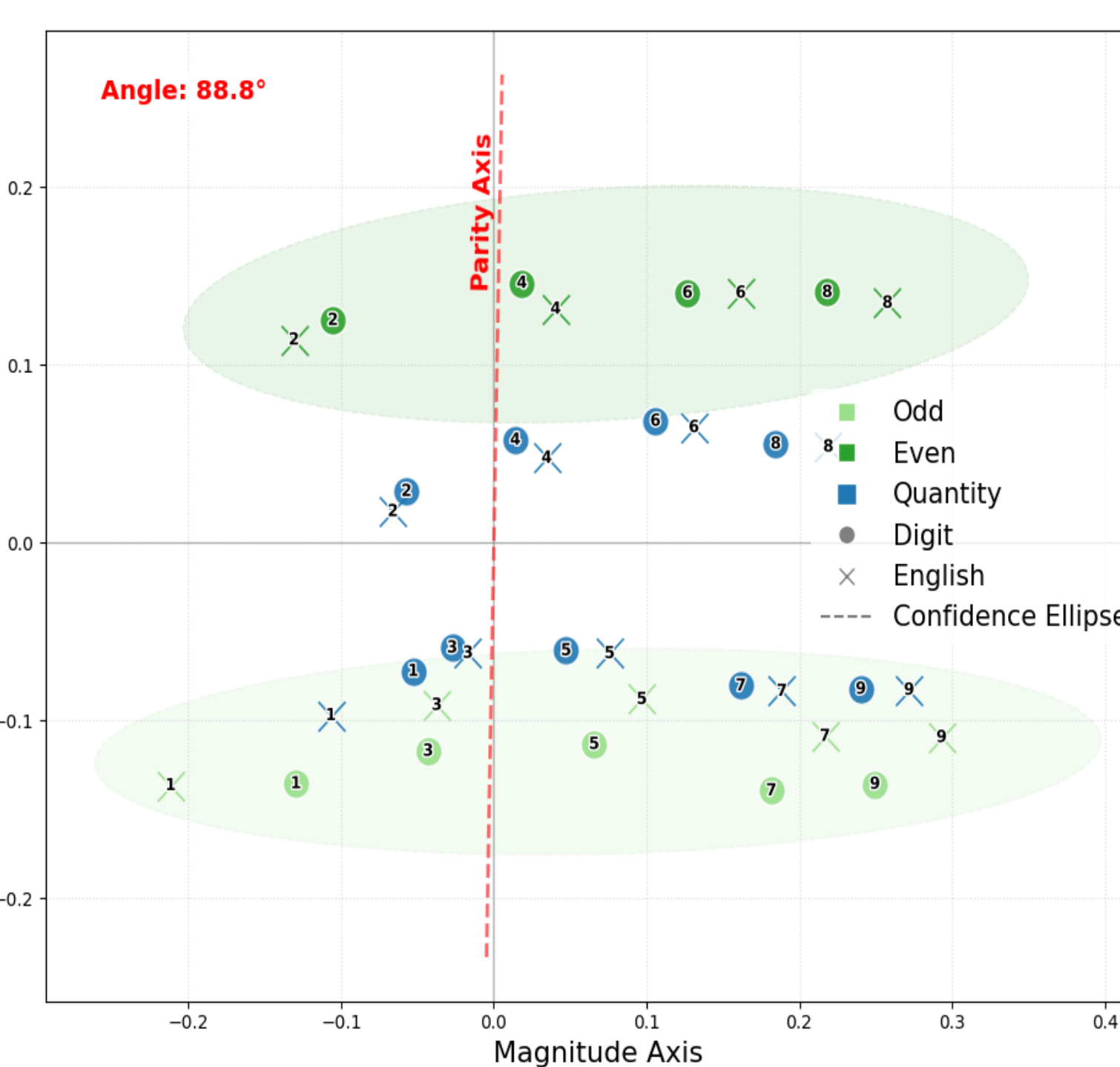
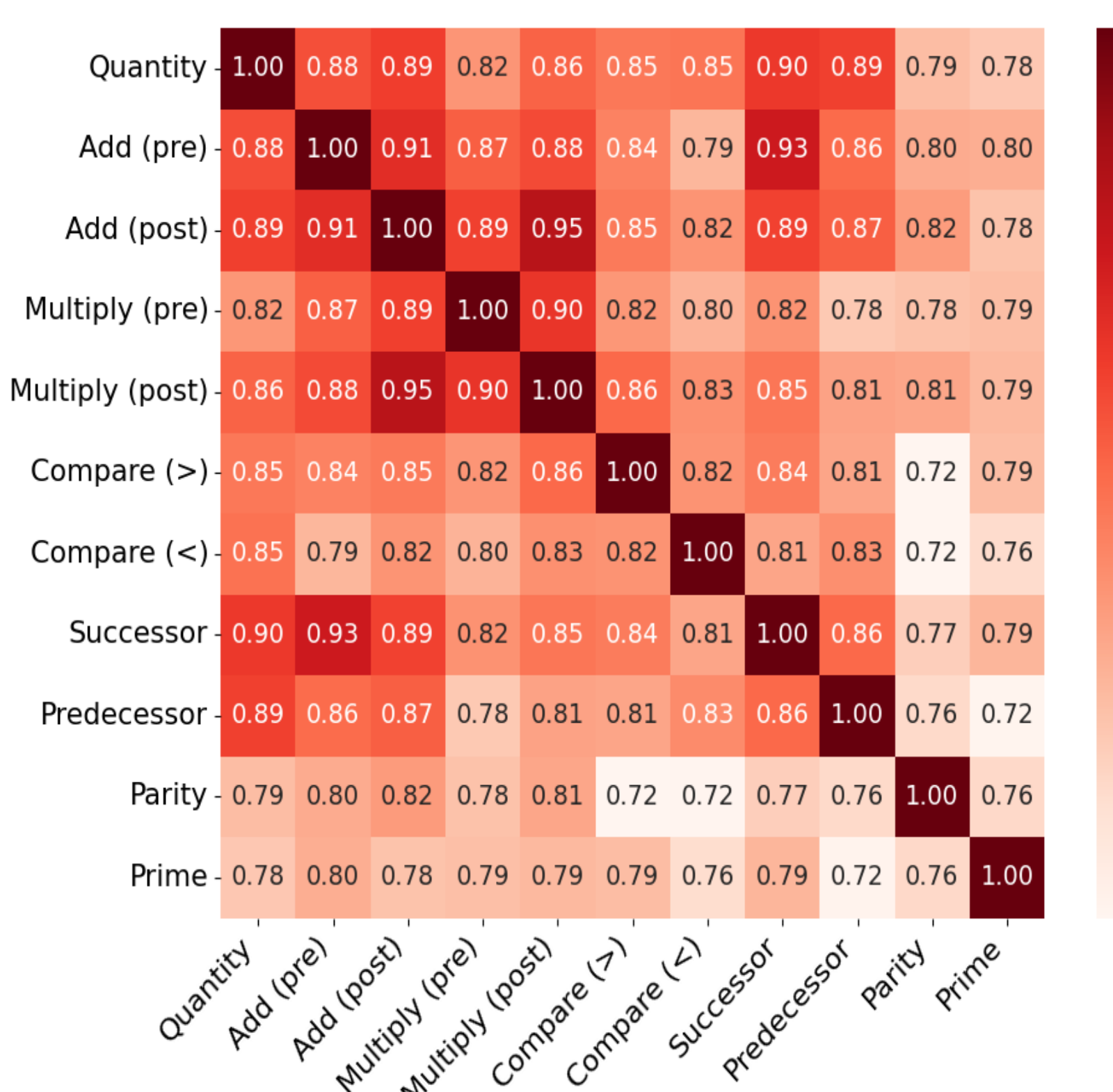
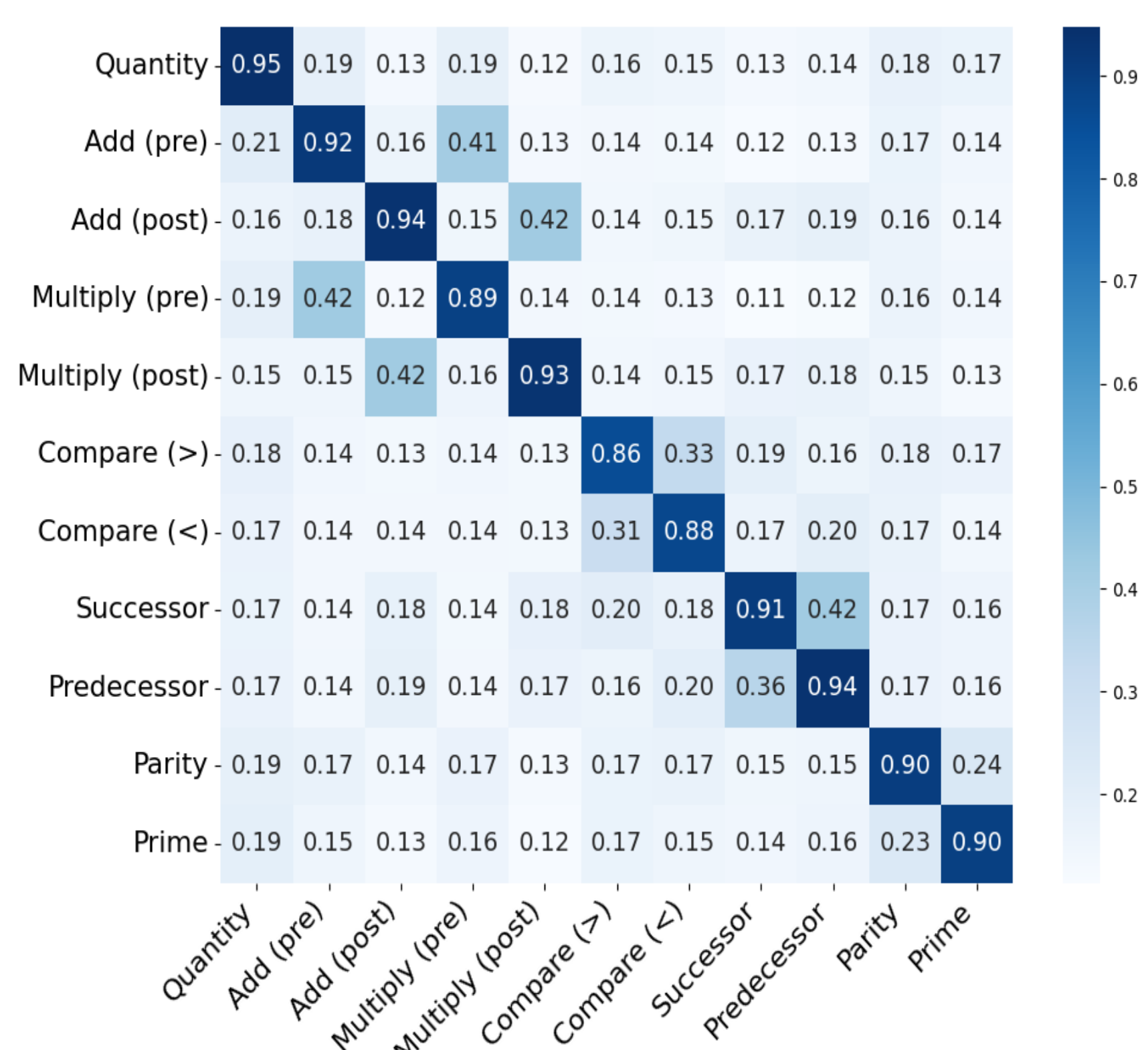
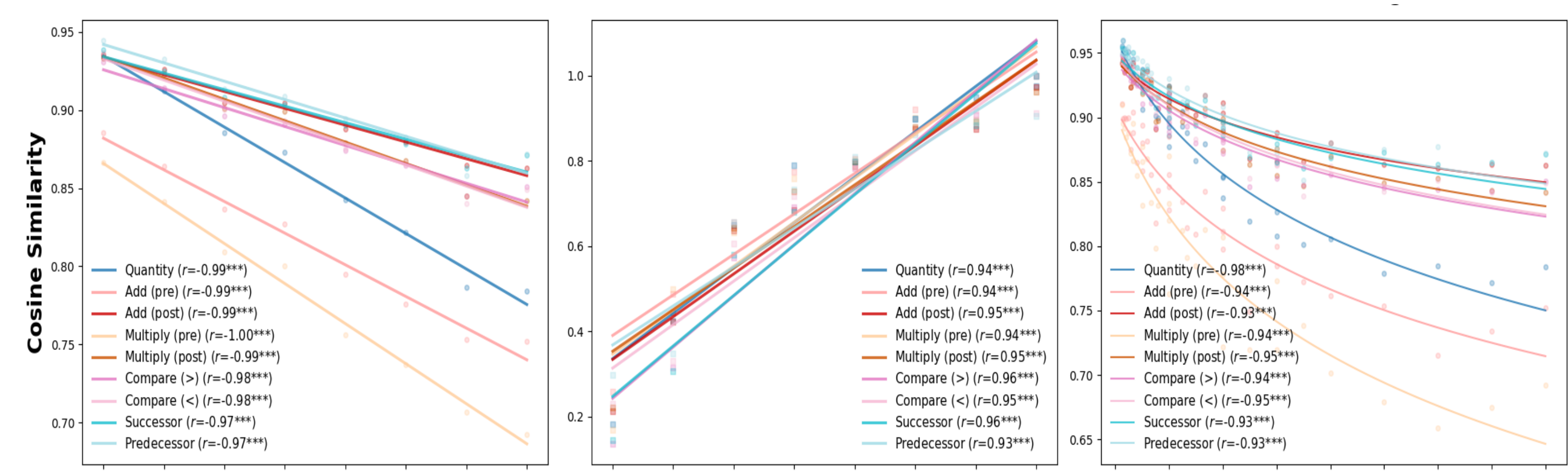
Results



Human Representation



Machine Representation



The number concepts are represented as structured geometric relations. Number features are encoded as linear directions. Each task spans a distinct subspace, yet they are largely related through linear transformations. It suggests that understanding arises when task-specific transformations are applied to a shared underlying relational structure of conceptual representations.