

Using Neighborhood-based Clustering to Categorize Visual Mental Imagery and Perceptual Domains

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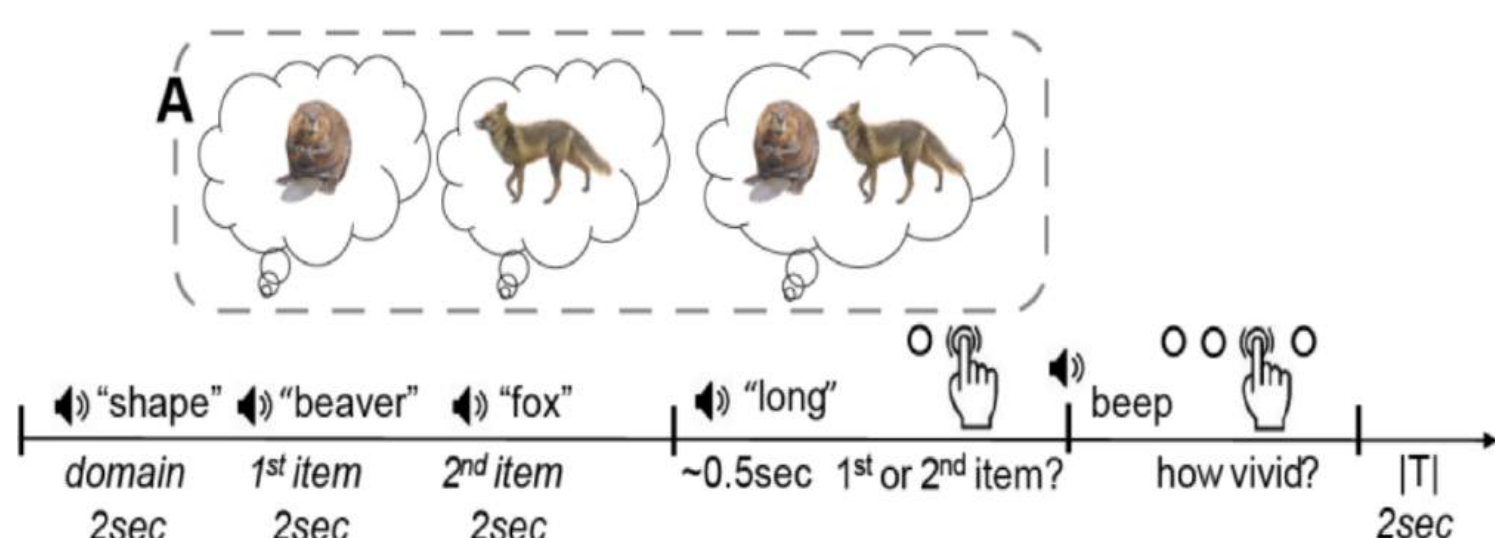
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Objective

Do both **visual mental imagery (VMI)** and **perception** exhibit **domain-specific clustering**? If yes, how similarly or differently?

Using an English adaptation of the French Enhanced Imagery and Perception battery (eBIP)^{1,2,3}, we aim to uncover the domain-specific nature of VMI and perception. By comparing performance scores, we seek to provide insights into their potential shared and distinct cognitive processes through dimension reduction and cluster analysis.

Procedure



The battery, built in Psychopy and ran via the online platform Pavlovia, consists of three tasks:

- 1. Vividness** of Visual Imagery Questionnaire (VVIQ) estimates one's vividness of the VMI;
- 2. Imagery:** auditory words;
- 3. Perception:** auditory with visual.

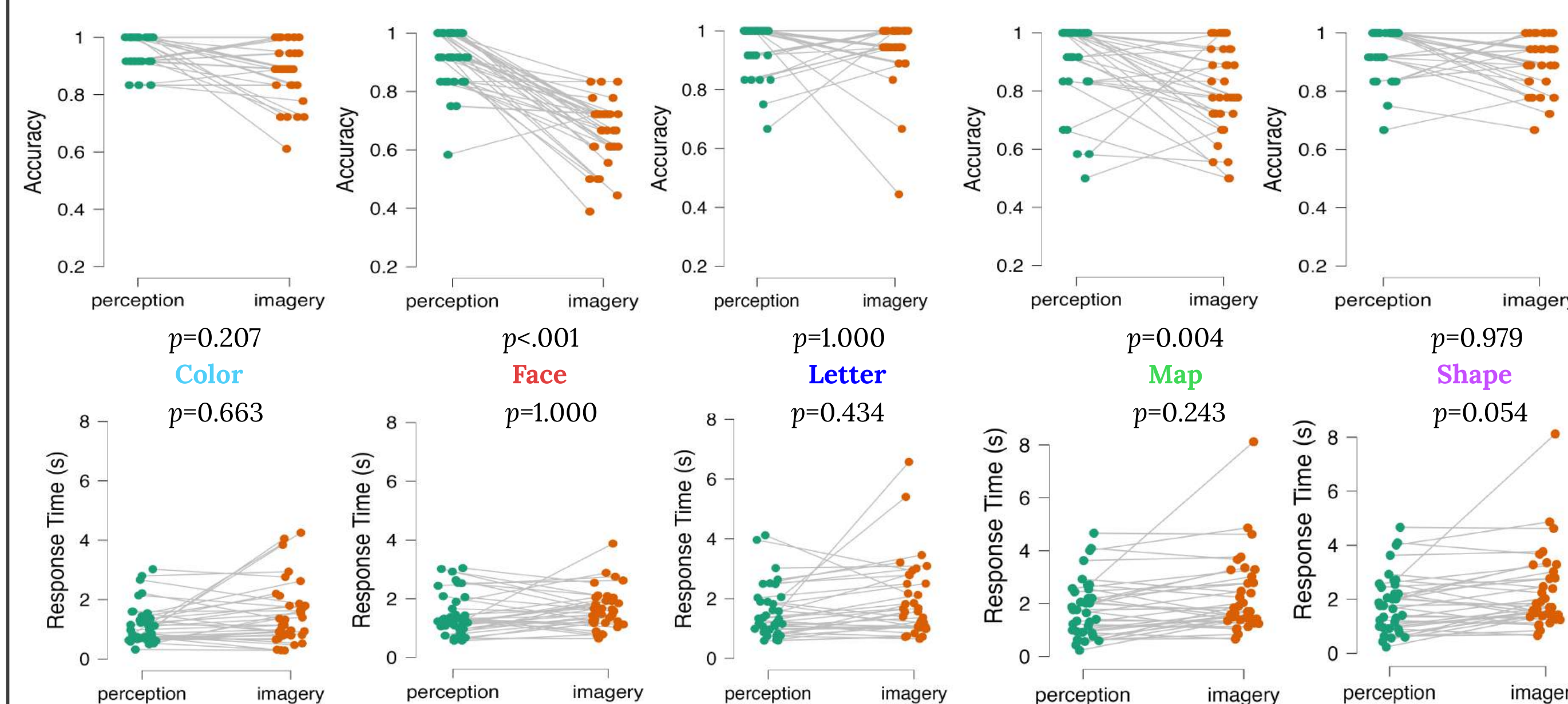
The **Imagery** and **Perception** tasks include 5 domains:

Color - **Face** - **Letter** - **Map** - **Shape**

We analyzed data from 36 participants (23 female) on these measures with age above 18 (M=33.5, SD=3.81).

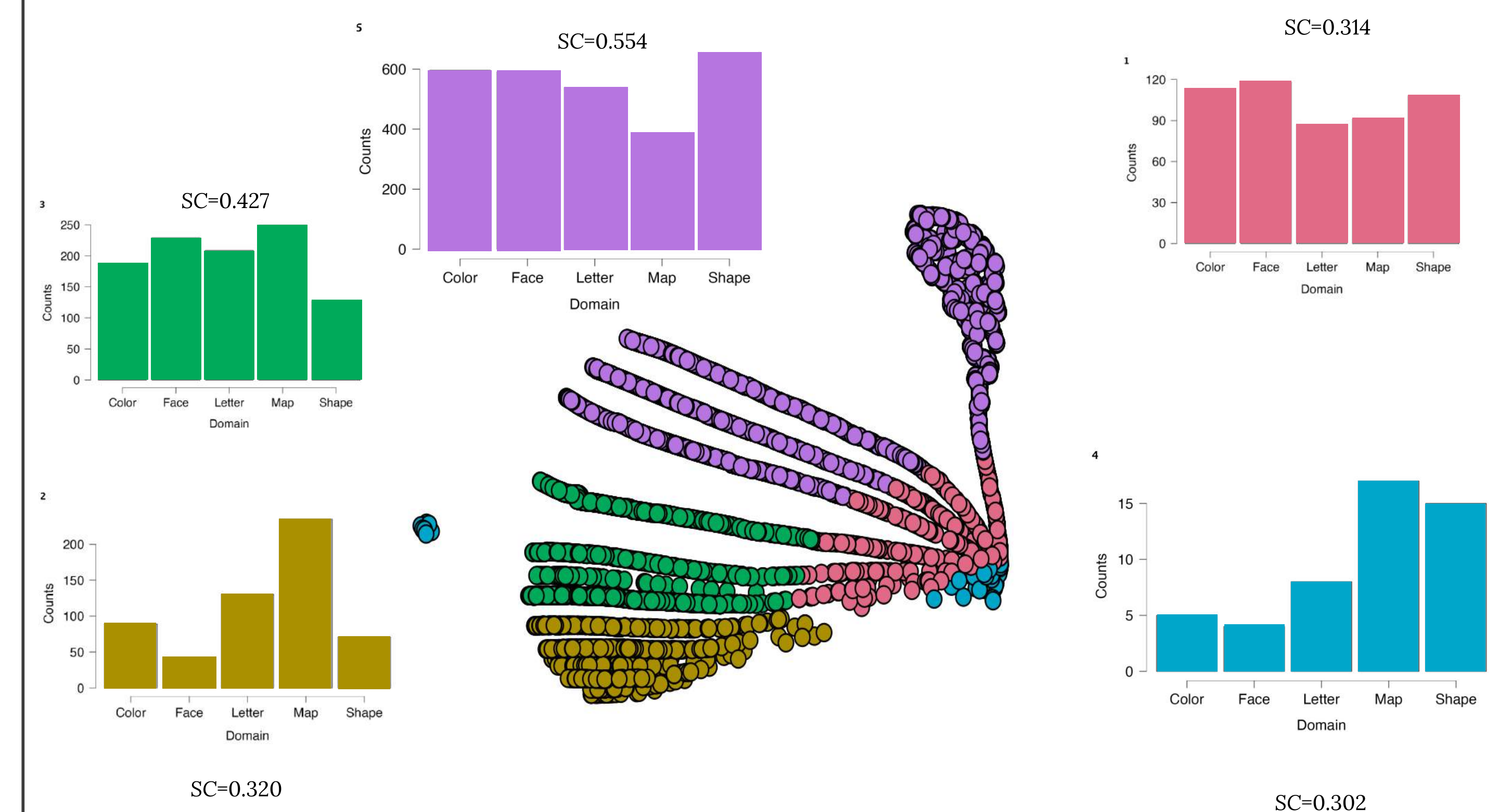
Domain Performance: Differences (Imagery & Perception)

Two-way ANOVAs on Accuracy and RT examining differences across domains and tasks (Imagery & Perception) found a significant interaction on accuracy. Post-hoc comparisons of the significant interaction showed that **accuracy** for **Face** and **Map** domains was significantly greater in perception than imagery.



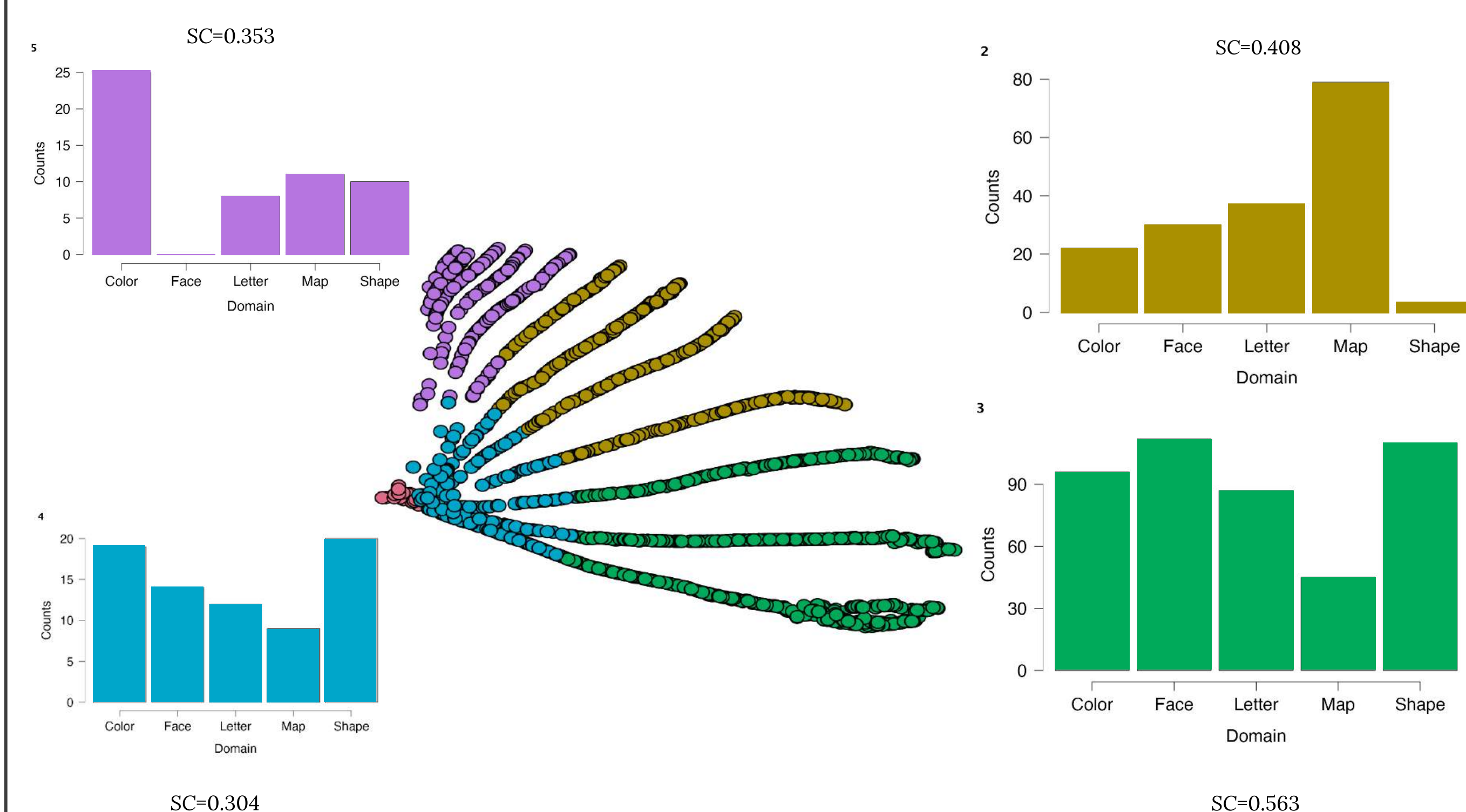
Domain Clustering: Overall

Utilizing neighborhood-based clustering, the optimum number of clusters was determined to be 5 based on the BIC criterion. The t-distributed stochastic neighbor embedding (t-SNE) plots provide visualization of the clusters.



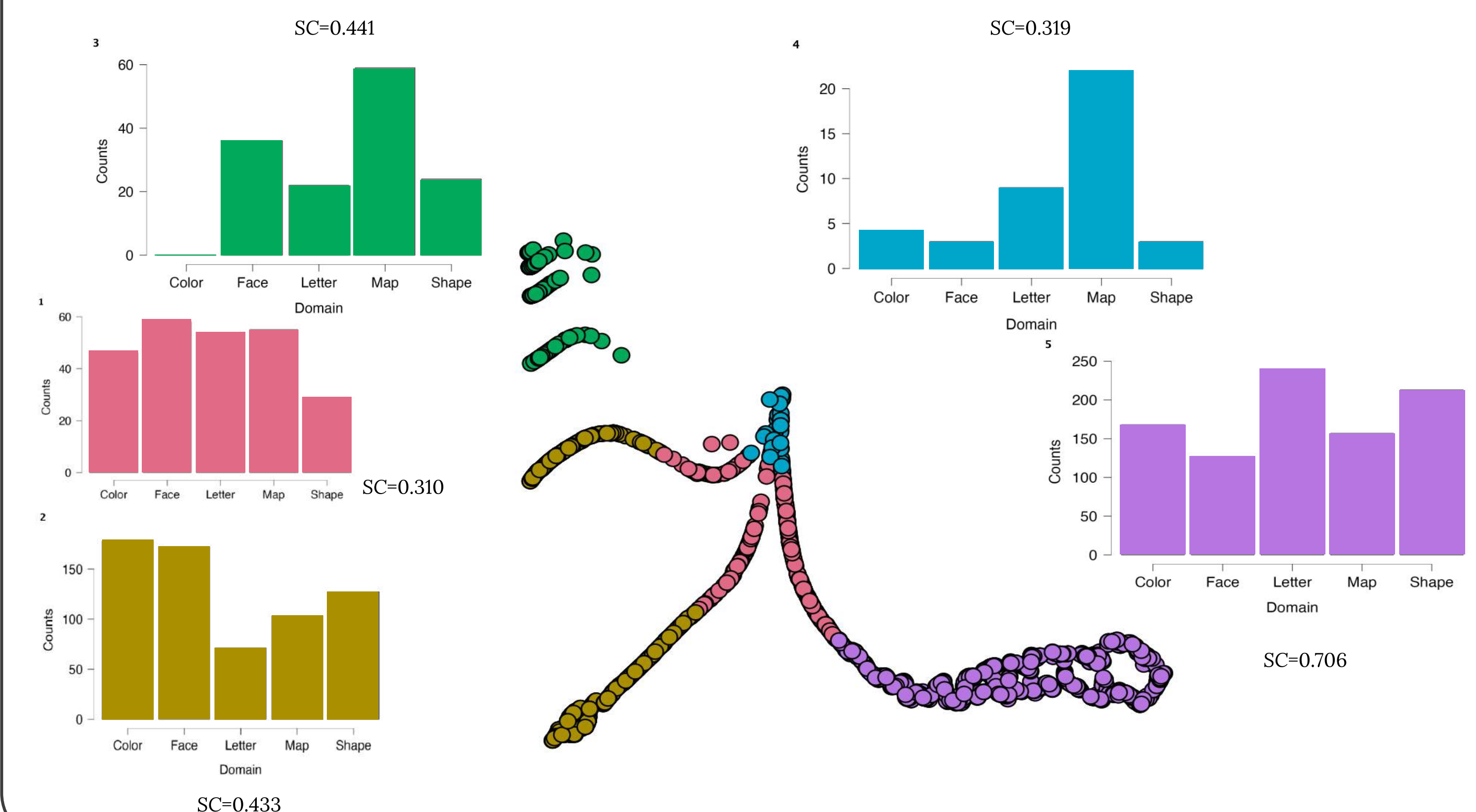
Domain Clustering: Imagery

Among imagery tasks, **Cluster 3** was the most cohesive cluster (1628 out of 3240); **Cluster 5** has the lowest center **accuracy**.



Domain Clustering: Perception

Among perception tasks, **Cluster 5** was the largest (1027 out of 2160); **Cluster 4** has the highest center **RT** and **Cluster 3** has the lowest center **accuracy**.



Conclusion: We provide evidence that VMI and perception abilities may cluster into fewer broader domains rather than the five predefined domains.

The temporal dynamics of VMI across newly defined domains will be further studied with eye-tracking and magnetoencephalography.

References: 1. Bartolomeo, P., et al. (2020). Assessing the causal role of early visual areas in visual mental imagery. Nat Rev Neurosci; 2. Spagna, A. (2022). Visual mental imagery: Inside the mind's eyes. Handb. Clin Neurol; 3. Boursillon, C., Chokron, S., ... Bartolomeo, P. (2009). Presentation of an assessment battery for visual mental imagery and visual perception. Rev Neurolog.