OPEN ACCESS
Vision Sciences Society Annual Meeting Abstract | September 2016

Human Visual Perception of the 17 Wallpaper-Group Patterns using Timed Trials

yanxi liu; Jeremy cole; david reitter

— Author Affiliations

yanxi liu
EECS, College of Engineering, Penn State University

Jeremy cole
College of Information Sciences and Technology

david reitter
College of Information Sciences and Technology

Journal of Vision September 2016, Vol.16, 950. doi:10.1167/16.12.950

Abstract

Most literature on symmetry perception has focused on bilateral reflection symmetry, with some suggesting that it is the only type of symmetry humans can perceive (Wilson&Wilkinson, Vis. Res. 42(5), 2002). Using image-stimuli generated from mathematically well-defined 17 wallpaper groups (Kohler et al., J. Neurosci., in press) and timed trials, we seek to demonstrate that humans can discriminate various symmetries found in 2D wallpaper patterns (Liu, et al Found.&Trends in Comp.Graph.&Vis., 2010). Furthermore, we examine which features play an essential role in wallpaper pattern perception. The features include: reflection, maximum order of rotation, glide reflection, tile shape and subgroup distance, referring to the shortest path between the two wallpaper groups in the group hierarchy. We recruited 106 individuals (Amazon Mechanical Turks) to compare three images (target, probe, probe) and to choose the probe most similar to the target within five seconds. Each participant performed 272 (=17x16) trials. Participants compare among all possible wallpaper group pairs. Every group comparison except one is distinguishable ($p < 0.05$); all are likely distinguishable ($p < 0.10$). After modeling every defining feature of symmetry groups using linear mixed-effects regression (GLMM), we used AIC selection to compare models. Our selected model includs subgroup distance, 3-fold rotation, 4-fold rotation, and the T1 and D1 axes. Even in a model with all other features, subgroup distance is a significant additional predictor ($p <$

0.0001). This distance measure has shown to be a better proxy describing human perceptual processes than individual features. This suggests that the mathematically motivated symmetry group hierarchy may be a valid model of pattern perception.

Meeting abstract presented at VSS 2016