Analysis of Glaucomatous Visual Field Patterns Found with Unsupervised Learning Using Indpendent Component Analysis and Principal Component Analysis

MH Goldbaum[1,A], PA Sample[1,A], K Chan[1,B], T-W Lee[1,B], D McGuire[1,A], TJ Sejnowski[2] and RN Weinreb[1,A]

[A] Ophthalmology[B] Institute forNeural Computing[1] University of California at San Diego La Jolla CA
[2] Computational Neurobiology Laboratory Salk Institute La Jolla CA

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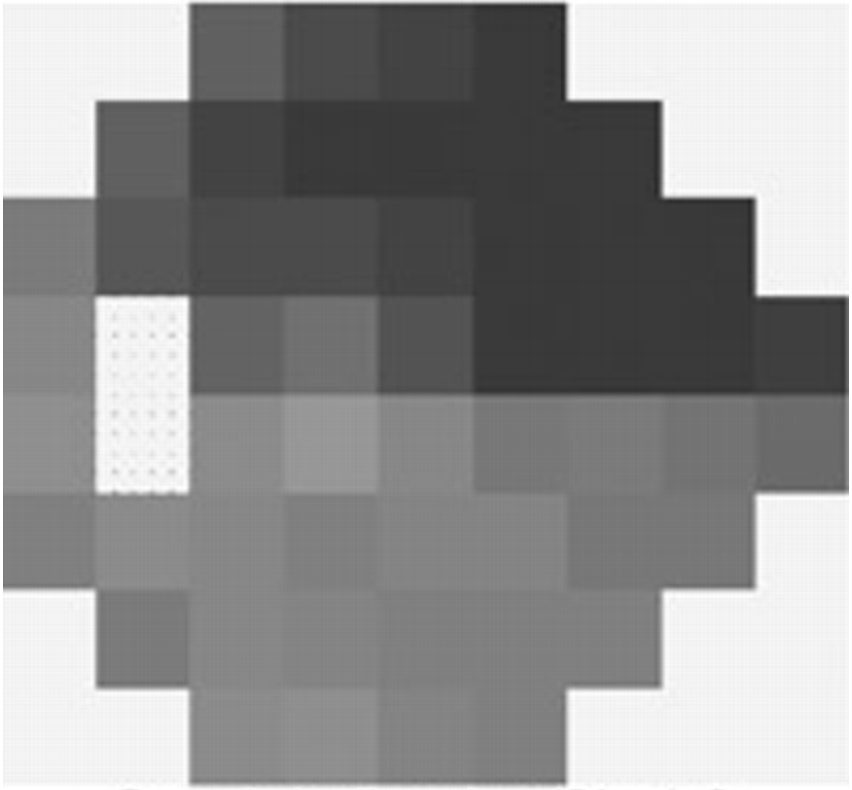
Abstract

Purpose: To uncover known and new patterns representative of glaucoma from standard automated perimetry.
Methods: Data came from 156 eyes with and 189 eyes without glaucomatous optic neuropathy, determined by masked stereophoto evaluation. We used 2 methods of unsupervised learning. In method 1, we partitioned the glaucoma and normal populations into clusters with principal component analysis (PCA) and ranked them by variance. We analyzed the pattern closest to the centroid of each cluster as representative of that cluster. In method 2, with independent component analysis (ICA) we found 5 axes with maximal independence in the glaucoma population and 2 axes in the normal population and ranked them by variance. Along each glaucoma axis, we generated the visual field patterns with respect to normal centroid at ± 1 standard deviation from the glaucoma centroid.
Results: We found expected glaucoma patterns such as nasal step defects, arcuate defects, and altitudinal hemifield defects. We also uncovered nonstandard defects which may be important for diagnosing glaucoma.
Conclusion: Decades of experience have led to the reliance by clinicians on typical patterns for diagnosing glaucoma. Other patterns uncovered by unsupervised learning may also be diagnostic for glaucoma.



Generated pattern along ICA axis 2,
1 sd from glaucoma centroid

Keywords: 624 visual fields • 364 computational modeling