Defining Change Thresholds: What change is outside typical sources of variation?

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Abstract

Researchers often have a difficult time defining meaningful thresholds for change. We sometimes identify subtle changes but what amount of change is beyond typical sources of variation? This is especially complicated when trying to understand new disease pathogenesis like the constellation of eye changes leading to Spaceflight-associated Neuro-ocular Syndrome (SANS). To support decision makers in defining minimal meaningful change, we used a Bayesian hierarchical model to estimate innate sources of variability such as natural day to day variation. Healthy subjects were recruited and imaged with MRI, OCT, and US on separate days and measured by several technicians. Models were developed specifying random effects for the sources of variation – between left and right eyes, within-individuals over time, between raters, and finally between individuals. This allowed us to find the posterior distribution for the total typical variation, within an eye, which we use to define a threshold where change beyond typical sources of variation is likely. This threshold is now used as our earliest indicator of systematic increase in Total Retinal Thickness (a precursor to optic disc edema)[1].

Key Words: change relevance, decision support, NASA, Spaceflight

References:

1. Laurie SS, Lee SM, Macias BR, et al. Optic Disc Edema and Choroidal Engorgement in Astronauts During Spaceflight and Individuals Exposed to Bed Rest. *JAMA Opthalmol*. 2020 Feb 1;138(2):165-172