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View Abstract

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Study Group: (none)

ABSTRACT
TITLE: Synaptic plasticity models predict that binocular treatments for amblyopia can outperform monocular treatments
ABSTRACT BODY:
Purpose: Amblyopia is a common cause of visual impairment that results from unequal visual inputs during development, known to manifest through synaptic alterations in the visual cortex. What is not known is the detailed mechanisms of these synaptic changes and how these mechanisms impact the dynamics of recovery. Here we use a computational model of neural plasticity to compare multiple treatment strategies.

Methods: This study used a specific model of activity-dependent neural plasticity, the Bienenstock, Cooper, and Munro (BCM) model, to compare the dynamics of amblyopia recovery at the neuronal level under several treatment protocols, including optical correction, patching, atropine penalization, and binocular therapies. This study extends prior work in this area by exploring multiple sources for amblyogenesis including refractive error and strabismus, and it compares multiple treatment protocols.

Results: BCM modeling recapitulated anisometropic amblyopia, but ocular dominance remained stable even when simulating large angle strabismus. The recovery achieved with dichoptic masks combined with an interocular contrast disparity exceeded that of patch and atropine treatments. Patch and atropine treatment models produced faster recovery compared to a contrast disparity alone, highlighting the importance of the dichoptic masks. The rate of recovery depended on treatment features such as the size of the dichoptic masks and the magnitude of the contrast disparity, both experimentally accessible. The model suggests optimal values for these modifications.

Conclusions: The BCM theory of synaptic plasticity is sufficient to model anisometropic but not all of strabismic amblyopia, suggesting additional aspects of synaptic plasticity and/or circuit dynamics that produce an ocular dominance shift with strabismus (e.g. suppression). The near infinite potential modifications and combinations of eye-selective visual input in dichoptic therapy cannot be practically tested in dedicated clinical trials. Computational modeling can thus serve as a useful tool to compare therapeutic approaches and make specific clinical predictions to answer key lingering questions and inform improvements to binocular treatments using principles of neuroplasticity.

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DETAILS
PRESENTATION TYPE - PLEASE NOTE, IF YOU CHANGE YOUR PRESENTATION TYPE AFTER APPLYING FOR AN AWARD (BELOW), YOU MUST GO BACK AND RESELECT THE APPLY BUTTON.: #1

Paper, #2 Poster

CURRENT REVIEWING CODE: 1290 Amblyopia

CURRENT SECTION/GROUP: Eye Movements/Strabismus/Amblyopia/Neuro-Ophthalmology

Clinical Trial Registration (Abstract): No

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Registration Number (Abstract): (none)

Date Trial was Registered (MM/DD/YYYY) (Abstract): (none)

Date Trial Began (MM/DD/YYYY) (Abstract): (none)

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AWARDS:
