BIOGRAPHICAL SKETCH

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NAME: Nallour Raveendran, Rajkumar

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Postdoctoral Research Fellow

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	END DATE MM/YYYY	FIELD OF STUDY
Elite School of Optometry, Chennai, TamilNadu	BS	07/2009	Optometry
School of Optometry and Vision Science, University of Waterloo, Waterloo, Ontario	MS	04/2013	Vision Science
School of Optometry and Vision Science, University of Waterloo, Waterloo, Ontario	PHD	07/2017	Vision Science
Computational Sensory-Motor Neuroscience (CoSMo), Kingston, Ontario	Other training	08/2013	
Envision Research Institute, Wichita, KS	Postdoctoral Fellow	present	

A. Personal Statement

During my PhD research work, I have acquired expertise and training to carry out research projects involving visual processing and eye movements. My PhD research was about understanding the causal relationship between sensory deficits such as reduced visual acuity, impaired binocular functions and impaired stability of fixational eye movements in observers with amblyopia. For my PhD research, I successfully secured funds from the Canadian Optometric Education Trust Fund (COETF) for continuous four years (2013 – 2016). I also collaborated in a multi-center clinical trial (A randomized clinical trial for binocular treatment of amblyopia (BRAVO)) and acquired knowledge and training in conducting a large scale clinical trial. I have a broad background in clinical optometry which includes 1) clinical optometric practice in Glaucoma & Neuro-optometry for one year, and 2) teaching clinical optometry techniques as a teaching assistant at the School of Optometry & Vision Science, University of Waterloo for 6.5 years. At present, I am an LC Industries Research Fellow with Envision Research Institute (Wichita, KS), working under the mentorship of Dr. Benjamin Thompson, an Associate Professor at the University of Waterloo, Ontario, Canada. My current research investigates non-invasive brain stimulation and visual rehabilitation in people with low vision.

1. Raveendran RN, Bobier W, Thompson B. Impaired fixation stability in amblyopia cannot be explained by the visual acuity impairment.. OSA Fall Vision Meetings; 2016; The Association for Research in Vision and Ophthalmology; c2017.
2. Raveendran RN, Bobier W, Chow A, Babu R, Thompson B. Fixational eye movements during binocular rivalry. ARVO; 2015; The Association for Research in Vision and Ophthalmology; c2015.
3. Raveendran RN, Babu RJ, Hess RF, Bobier WR. Transient improvements in fixational stability in strabismic amblyopes following bifoveal fixation and reduced interocular suppression. Ophthalmic Physiol Opt. 2014 Mar;34(2):214-25. PubMed PMID: 24495165.
4. Raveendran RN, Babu R, Hess R, Bobier W. Improvement of fixational stability in strabismic amblyopes with ocular alignment and binocular summation. ARVO; 2013; Seattle, USA. The Association for Research in Vision and Ophthalmology.

B. Positions and Honors

Positions and Employment

2009 - 2010	Optometrist, Sankara Nethralaya, Chennai
2010 - 2017	Teaching Assistant, University of Waterloo, Waterloo
2010 - 2017	Graduate Researcher, University of Waterloo, Waterloo
2017 -	Postdoctoral Research Fellow, Envision Research Institute, Wichita, KS

Other Experience and Professional Memberships

2013 - 2016	Member, The Association of Research in Vision and Ophthalmology

Honors

2007	Best Student Award, Elite School of Optometry
2011 - 2016	Graduate Award for academic excellence, University of Waterloo
2013	Special Graduate Award, University of Waterloo
2013	Travel Fellowship/Grant, Interaction of Vision, York University
2013 - 2016	Research Grant, Canadian Optometric Education Trust Fund (COETF)
2017	Doctoral Thesis Completion Award, University of Waterloo

C. Contribution to Science

1. **Fixational eye movements and sensory deficits of amblyopia**

   My PhD research investigated the causal relationship between sensory deficits such as reduced visual acuity, impaired binocular functions, and impaired stability of fixational eye movements in observers with amblyopia. Previously, it was thought that reduced visual acuity leads to impaired stability of fixation in the amblyopic eye. However, the results of my research showed that impaired fixation stability could be responsible for reduced visual acuity in the amblyopic eye. My research also found that impaired fixational eye movements should be considered as one of the important factors for the effective management of amblyopia.

   Role: Student (Ph.D.) investigator

   a. Raveendran RN, Bobier W, Thompson B. Impaired fixation stability in amblyopia cannot be explained by the visual acuity impairment. OSA Fall Vision Meetings; 2016; The Association for Research in Vision and Ophthalmology; c2017.
   b. Raveendran RN, Bobier W, Babu R, Thompson B. Interocular contrast differences and the stability of fixational eye movements. ARVO; 2016; The Association for Research in Vision and Ophthalmology; c2016.
   c. Raveendran RN, Bobier W, Chow A, Babu R, Thompson B. Fixational eye movements during binocular rivalry. ARVO; 2015; The Association for Research in Vision and Ophthalmology; c2015.
   d. Raveendran RN, Babu RJ, Hess RF, Bobier WR. Transient improvements in fixational stability in strabismic amblyopes following bifoveal fixation and reduced interocular suppression. Ophthalmic Physiol Opt. 2014 Mar;34(2):214-25. PubMed PMID: 24495165.

2. **Binocular Treatment of Amblyopia using Videogames (BRAVO)**

   Binocular treatment of amblyopia using contrast-rebalanced stimuli showed promise in laboratory studies and required formal clinical trial investigation in a home-based setting. A multicenter, double-blinded, randomized clinical trial [Binocular Treatment of Amblyopia using Videogames (BRAVO)] was designed to investigate the effectiveness of a binocular videogame against placebo for improving visual functions in older children and adults.

The results of the clinical trial showed that the current home-based binocular “falling-blocks” videogame did not produce a treatment effect, thus outcomes did not differ from the placebo videogame. This illustrates the difficulty of translating supervised, laboratory-based treatments to a home-based setting.

Role: In this clinical trial, my role was the Unmasked observer at the Waterloo site. As the unmasked observers, my duty was to dispense the iPod devices to the patients, investigate the patient's compliance with videogames and documentation of compliance factors (such as score, playing time etc.). Moreover, as a trained optometrist, I also assisted my colleague in obtaining other relevant clinical data during the clinical trial.

a. Gao TY, Guo CX, Babu RJ, Black JM, Bobier WR, Chakraborty A, Dai S, Hess RF, Jenkins M, Jiang Y, Kearns LS, Kowal L, Lam CSY, Pang PCK, Parag V, Pieri R, Raveendren RN, South J, Staffieri SE, Wadham A, Walker N, Thompson B. Effectiveness of a Binocular Video Game vs Placebo Video Game for Improving Visual Functions in Older Children, Teenagers, and Adults With Amblyopia: A Randomized Clinical Trial. JAMA Ophthalmol. 2018 Jan 4;PubMed PMID: 29302694.
b. Guo CX, Babu RJ, Black JM, Bobier WR, Lam CS, Dai S, Gao TY, Hess RF, Jenkins M, Jiang Y, Kowal L, Parag V, South J, Staffieri SE, Walker N, Wadham A, Thompson B. Binocular treatment of amblyopia using videogames (BRAVO): study protocol for a randomised controlled trial. Trials. 2016 Oct 18;17(1):504. PubMed PMID: 27756405; PubMed Central PMCID: PMC5069878.

3. **Sensitivity Analysis of Schor’s adaptive model of accommodation-vergence**

Mathematical models of accommodation-vergence and its interaction have been developed using feedback control theory by Hung et al (1992) and Schor et al. (1986) to study the behaviors of accommodation and vergence systems. Sensitivity analysis is used to determine the output change of a model in response to changes in its parameter values. A mathematical model of accommodation-vergence (Schor's model) was created using Simulink, Matlab®, and the sensitivity analysis was then performed on the model. The results were then compared with the sensitivity analysis done by Hung (1994) on his own model. The results of these analyses found crosslink gains were the most sensitive parameter in the model as evident from the sensitivity coefficient calculations. This was similar to results obtained from Hung (1994). The plant gains of accommodation and vergence were the next most sensitive parameter in Schor's model. However, unlike Hung's model where the tonic system was shown to be a moderately sensitive parameter, the tonic system of the Schor's model was not a sensitive parameter which was evident from both sensitivity coefficient and sensitivity function calculations.

Role: Student Investigator

a. Raveendran RN, Bobier W, Lakshminarayanan V. Sensitivity Analysis of Schor’s adaptive model of accommodation-vergence. OSA Fall Vision Meetings; 2012 September; Rochester, NY, USA. Journal of Vision.

D. Additional Information: Research Support and/or Scholastic Performance

Ongoing Research Support

Envision Research Fellowship, LC Industries and Envision Research Institute (08/01/17-07/31/18)

Non-invasive brain stimulation and Visual Rehabilitation

Non-invasive brain stimulations (NIBS) alter the activity of the brain by applying either mild electric current (transcranial electrical stimulations - tES) or magnetic field (transcranial magnetic stimulations – TMS). Though NIBS techniques showed improvements of visual functions on neuro-developmental disorders such as amblyopia, very sparse number of attempts have been made in the low vision population caused due to macular degenerations, glaucoma and cortical blindness. Till date, the effect of tES on the excitation of the visual cortex of individuals with low vision has not been studied extensively. Few attempts such as transpalpebral electrical stimulation on wet AMD and dry AMD in human participants, and repetitive TMS on retinal dystrophy in rat models showed some promising effects of NIBS on visual functions such as visual

acuity and electroretinogram potentials, respectively. Therefore, the objective is to use NIBS techniques as a potential tool for visual rehabilitation.
Role: Principle Investigator