The influence of face identity noise on face recognition in healthy subjects and patients with mild traumatic brain injury - an equivalent noise approach.

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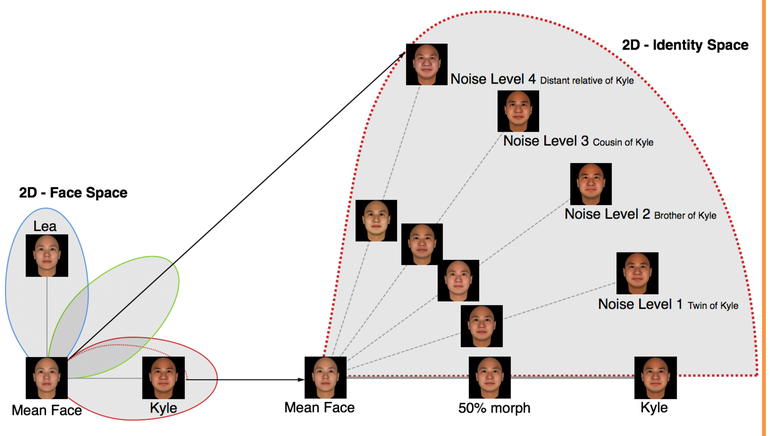
INTRODUCTION

- The impairment of visual functions is one of the most common complaints following. mild traumatic brain injury (mTBI) (Greenwald, Kapoor, & Singh, 2012, Kapoor & Ciuffreda, 2002).
- Previous studies have found evidence that TBI can affects early cortical visual processing, e.g.first and second-order stimuli (Spiegel et al., 2016) and stereopsis (Schmidtmann et al., 2017).
- TBIs are diffuse and can affect medial and anterior temporal lobes, areas also associated to face recognition (Bigler et al., 2002).

AIM

We aimed to investigate the influence of mTBI on face recognition using an equivalent noise paradigm.

METHODS



- Face identity sensitivity was measured as a function of external noise, defined as face identity noise
- Face identity thresholds were measured between a mean face two different identities
- Synthetic face stimuli were generated using a software (FaceGen Modeller 3.5; Singular Inversions Inc., 2016), which allowed us to precisely control the amount of identity noise for a given face identity.
- Various face identity noise levels, e.g. a twin, sibling, cousin or distant relative (four noise levels) were created for each morph level between a mean face and the two individual identities (Kyle & Lea)

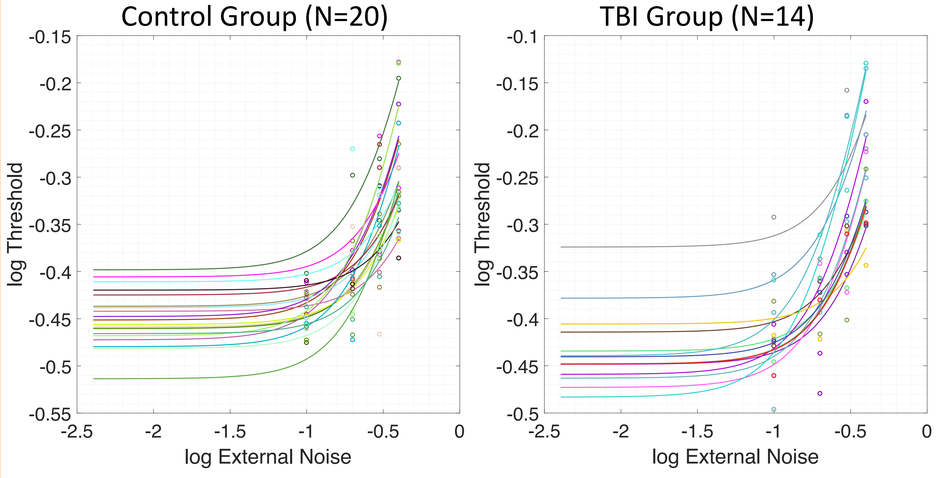
MODEL

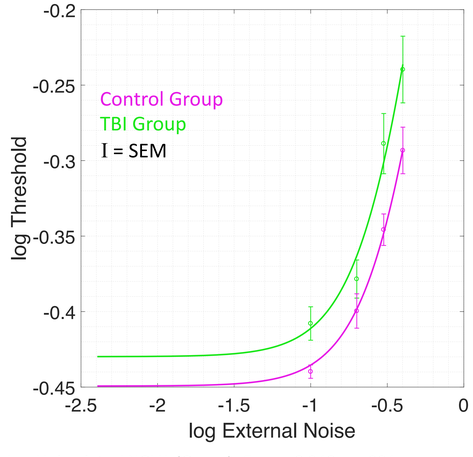
- To estimate the amount of internal noise and efficiency, we applied the equivalent noise paradigm and fit a Linear Amplifier Model (LAM) to the data (Baldwin et al., 2016; Lu & Dosher, 2008)

$$A_{\text{threshold}} = \frac{\sqrt{\sigma_{\text{ext}}^2 + \sigma_{\text{int}}^2}}{\beta}$$

- σ_{ext} is the standard deviation of the external noise added to the stimulus, σ_{int} is the standard deviation of the *equivalent* internal noise in the visual system, and β represents the efficiency of the processing performed on the input.

RESULTS





- Thresholds – Univariate ANOVA (Group): $F_{1,175} = 8.349$, p=.004,
- Shapiro-Wilk Test: internal noise: p_c=.229, p_i=.541; efficiency: p_c=.157, p_i=.446
- One-Way ANOVA (Control vs. TBI): internal noise: $F_{1,32} = 2.924$, p=.097, efficiency: $F_{1,32} = 5.937$, p=.021

RESULTS

- Results show that face identity thresholds increase with increasing face identity noise in both groups.
- Thresholds are significantly increased for all noise levels in mTBI patients compared to control subjects.
- Compared to the control group, TBI patients have significantly lower efficiency in this task.
- However, internal noise is not increased in the TBI group.

DISCUSSION

- mTBI affects the ability to recognize faces.
- Thresholds are increased for all noise levels.
- According to LAM, internal noise is not increased in TBI patients.
- The efficiency is decreased in the TBI group.
- The efficiency parameter β indicates how well the visual system makes use of the noisy input information.
- i.e. better processing strategies applied to the input give higher efficiencies, approaching the ideal observer which uses the best possible strategy

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