



ANU

Non-contact, rapid, visual multifocal diagnosis of multiple sclerosis

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Financial Disclosures

- Financial interests or relationships to disclose:
 - CJ Lueck: none
 - C Voicu: none
 - T Maddress: Carl Zeiss Meditec, patents, royalties for the FDT/Matrix perimeters
 - T Maddress: EyeCo Ltd, consultant, equity
 - **T Maddress, AC James: Seeing Machines Pty, for TFA**
 - consultants
 - patents under license

Motivations for present study

- standard MRI scanning is correlated with history of inflammation, but less so with disability
- secondary degeneration continues after inflammation is controlled, so it might be related to the primary disease process
- ***sparse multifocal*** VEPs are correlated with degeneration not inflammation history: high sensitivity and specificity for RRMS, *even in eyes with no history of ON* [Ann Neurol 2005; **57**:904–13]
- Recently we have demonstrated *sparse multifocal* methods in eye diseases using ***responses of the pupils*** [IOVS 2010; **51**: 602-8, CEO 2009; **37**: 678-86]

Aims

- To examine the diagnostic power of the TrueField Analyser (TFA) in multiple sclerosis (MS)
- In particular to see if, as in our earlier sparse mfVEP study, the diagnostic performance of TFA would follow
 - the history of inflammatory attacks
 - or the degree of disability
- In doing that we were also examining the equivalence of sparse stimulus mfVEPs, and non-contact multifocal pupillography (TFA), for diagnosing MS
- the presence or absence of ON was used as a marker for a history of acute inflammation
- primary and secondary MS also investigated.



Subject Data

- 35 normal subjects: 47.9 ± 16.8 yr, 22 women
- 85 MS subjects: 49.8 ± 11.3 yr, 62 women
 - 2 primary progressives
 - 11 secondary progressives
 - the remainder relapsing remitting (RR)
- Disability scores (EDSS)
 - RR patients: 3.53 ± 1.04
 - Primary or Secondary (PorS): 5.9 ± 1.43

- [TrueField Analyzer \(TFA\)](#)
- FDA 510K Clearance

(mean \pm SD)

Methods

- we replace the electrodes of VEPs with IR cameras
- **relative pupil diameter** measured (so small pupils OK)
- 60 degree diameter field, 44 stimulus regions/eye, independent stimuli for each eye (dichoptic)
- yielding direct and consensual responses for each visual field (alternatively test both eyes using 1 pupil)
- stimulus duration 4 min = **2 minutes / eye**
- each stimulus shown in **8 segments** each of **30 s**
- up to **15%** data loss from blinks, fixation losses permitted (if > 15%, then a 30 s segment is repeated)
- ROC analysis based on the response amplitudes, delays or a mix of both (ROC methods: IOVS 2010; 51: 602-8)

Results – ROC Area Under Curve (%AUC)

- Mean EDSS and %AUC were similar for ON vs. no ON

	no ON	ON
mEDSS	3.58 ± 0.98	3.48 ± 1.08
%AUC	75.7 ± 4.48	75.4 ± 3.84

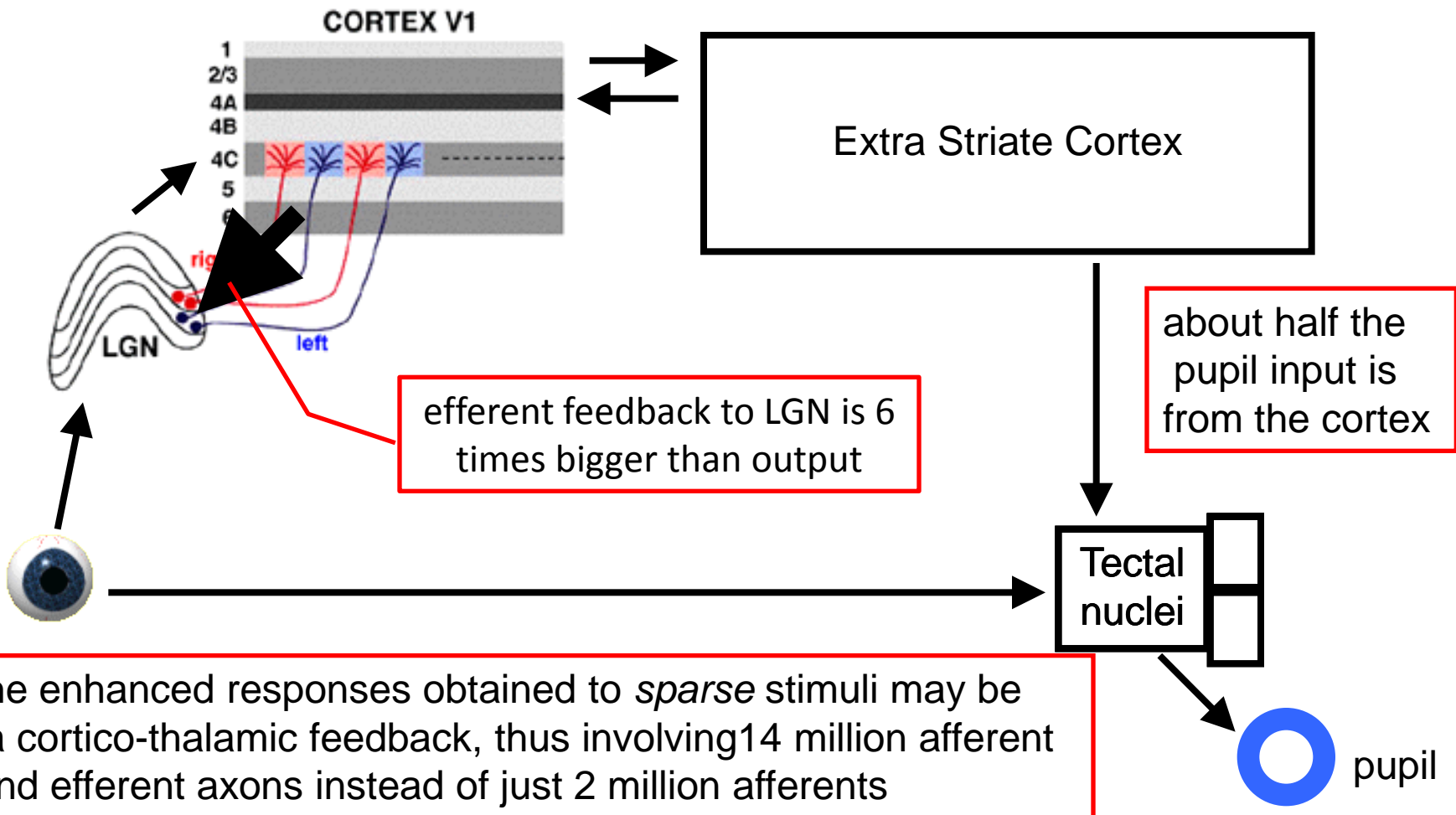
- So diagnostic performance (%AUC) DID NOT follow the history of acute inflammation
- RRMS patients
 - all RRMS: mEDSS 3.53 ± 1.04, %AUC = 75.0
 - RRMS with EDSS ≥5: mEDSS **5.29** ± 0.57, %AUC = **91.5**
- Primary or Secondary patients
 - mEDSS **5.90** ± 1.43, %AUC = **94.8**
- Overall, performance followed disability and degeneration

Conclusions

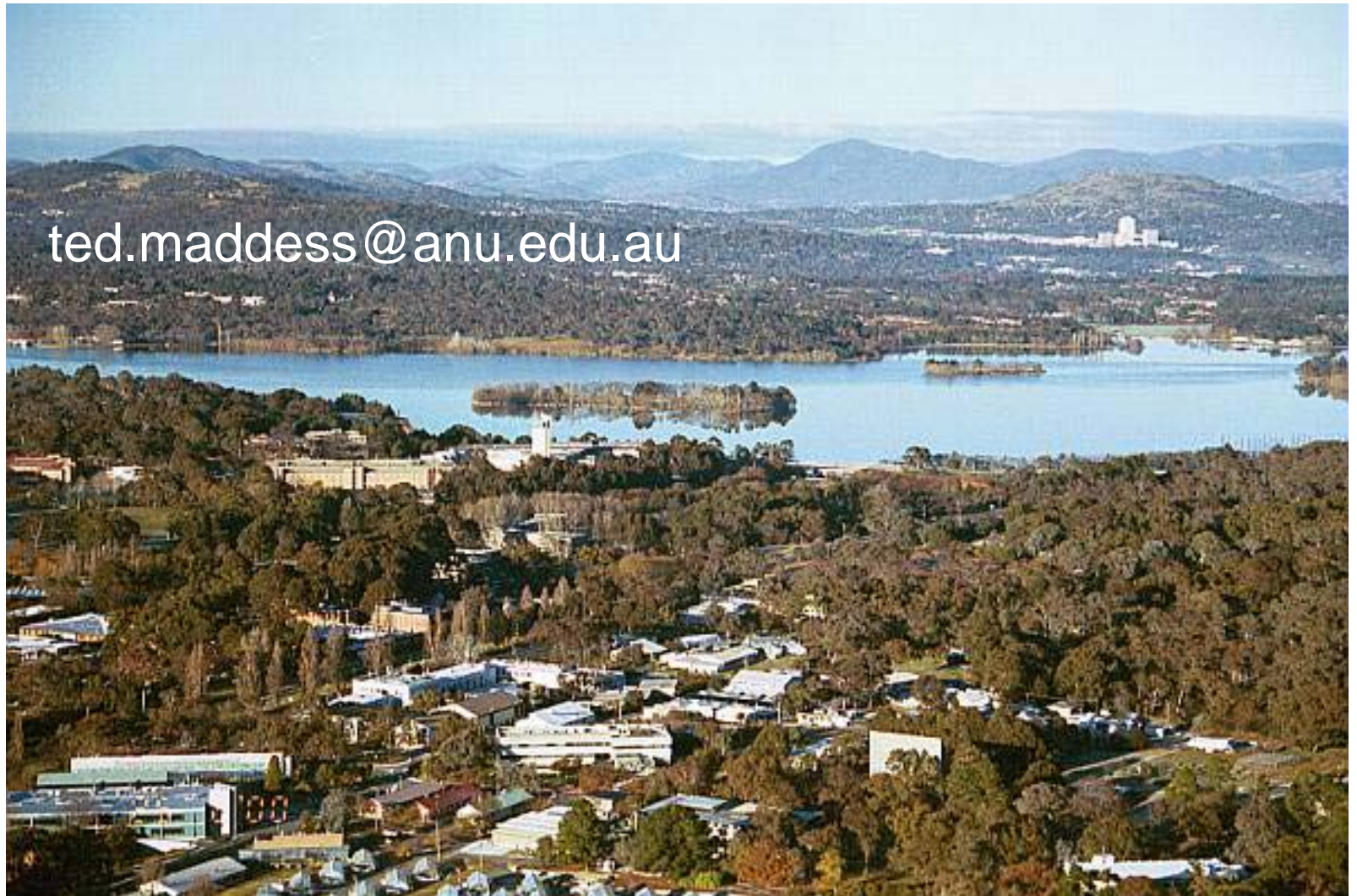
- The results mirrored those of our earlier mfVEP study
- ON had no significant effect on diagnostic performance
- RR and PS patients had %AUC consistent with EDSS scores
- suggesting that the results were more dependent on "secondary" degeneration than inflammation history
- possibly indicating that TFA can track disease processes related to degeneration
- that would be useful in drug development, or periodic monitoring of patient status in a cost-effective manner

Possible explanations?

the pupil pathway(s) sample(s)
a lot of white matter



Thanks for reading!



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