

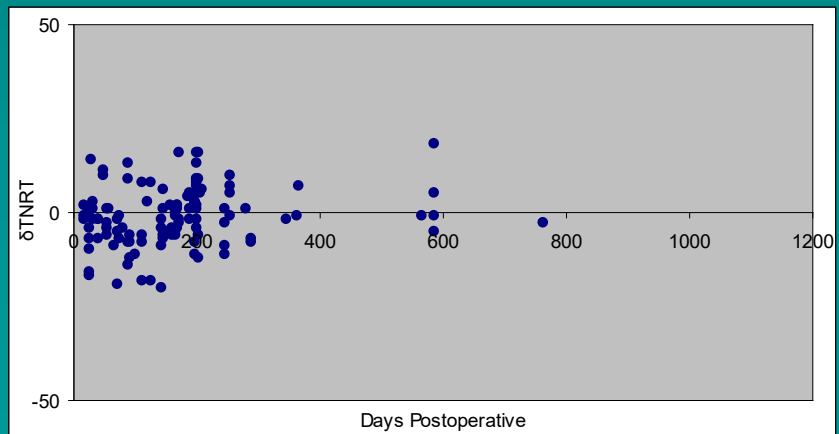
Long term observations of the NRT Threshold across the electrode array & implications for speech processor fitting

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Introduction

- Clinical use of NRT data involves the TNRT profile for approximating the profile of the Map T & C levels
- Further fine tuning involving behavioural interaction with the CI user is still required to optimise the Map
- Long term observations (Lai *et al*, 2003) suggest that the neural response amplitudes are generally stable in the long term, and any changes are more likely to occur within the first year after implantation
- Changes in TNRT, however, remained reasonably small (within system measurement error) and constant over time



Cross-array changes

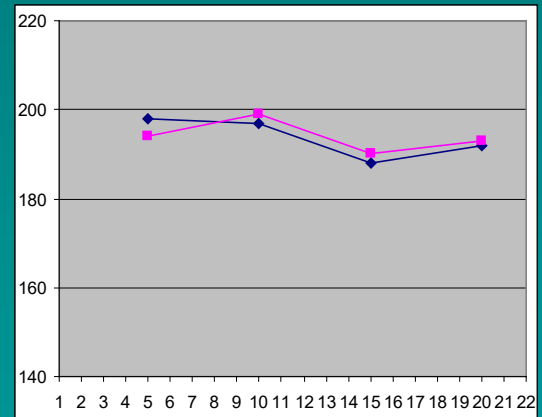
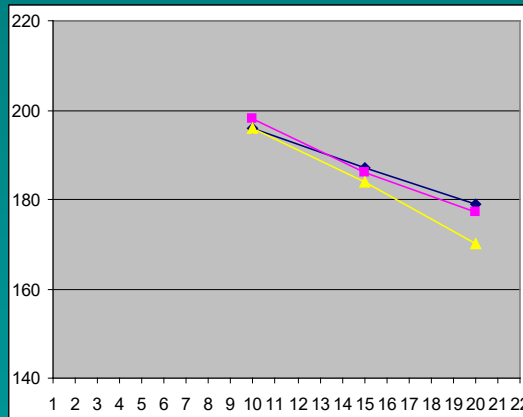
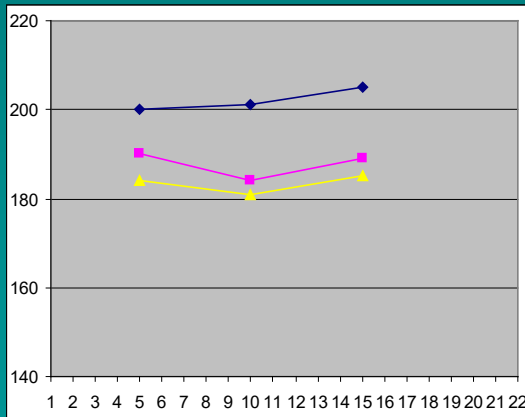
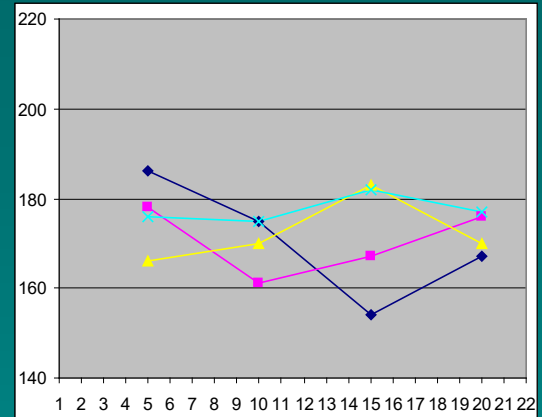
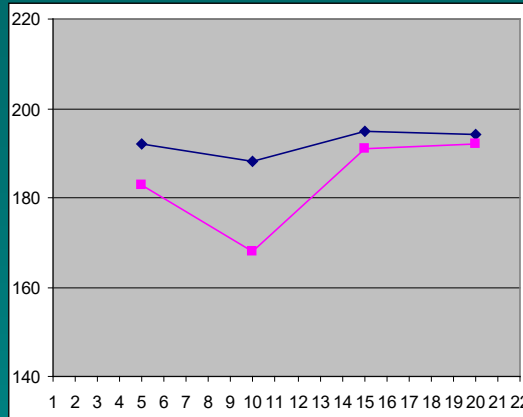
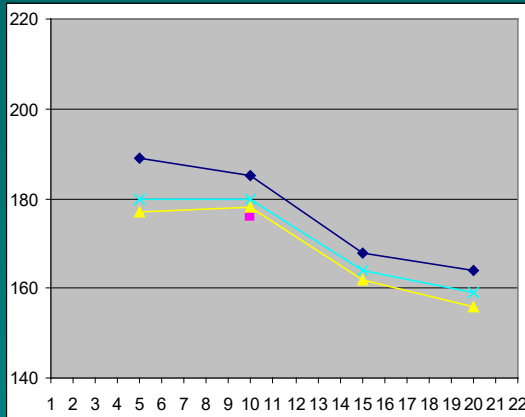
- The collective TNRT data (Lai *et al*, 2003) did not distinguish between electrodes
- A closer analysis is desirable, where the changes in TNRT over time for each individual subject on each electrode, are taken into account
- How do TNRTs across the electrode array (ie. the profile) change over this time? How does this affect the approximation to actual Map T & C levels across the electrode array?
- We shall concentrate on intraoperative TNRT data, since these are the ones that will be used for the speech processor fitting.

Subjects and Data

- 26 subjects were monitored over 36 months from time of implantation
- TNRTs computed from AGFs collected from up to 4 electrodes (e05, e10, e15 & e20) evenly spread out across the array
- Intraoperative TNRT data as the baseline, and compared to subsequent (postoperative) data for changes
- TNRT also compared with Map T & C levels from the same day when the postoperative NRT data was collected
 - dT: difference between TNRT and T-level
 - dC: difference between TNRT and C-level

TNRT Profiles over time

Examples of TNRT profiles from 6 subjects. Each curve represents a profile from one session. Some subjects exhibit profiles that remain parallel to each other, others not.

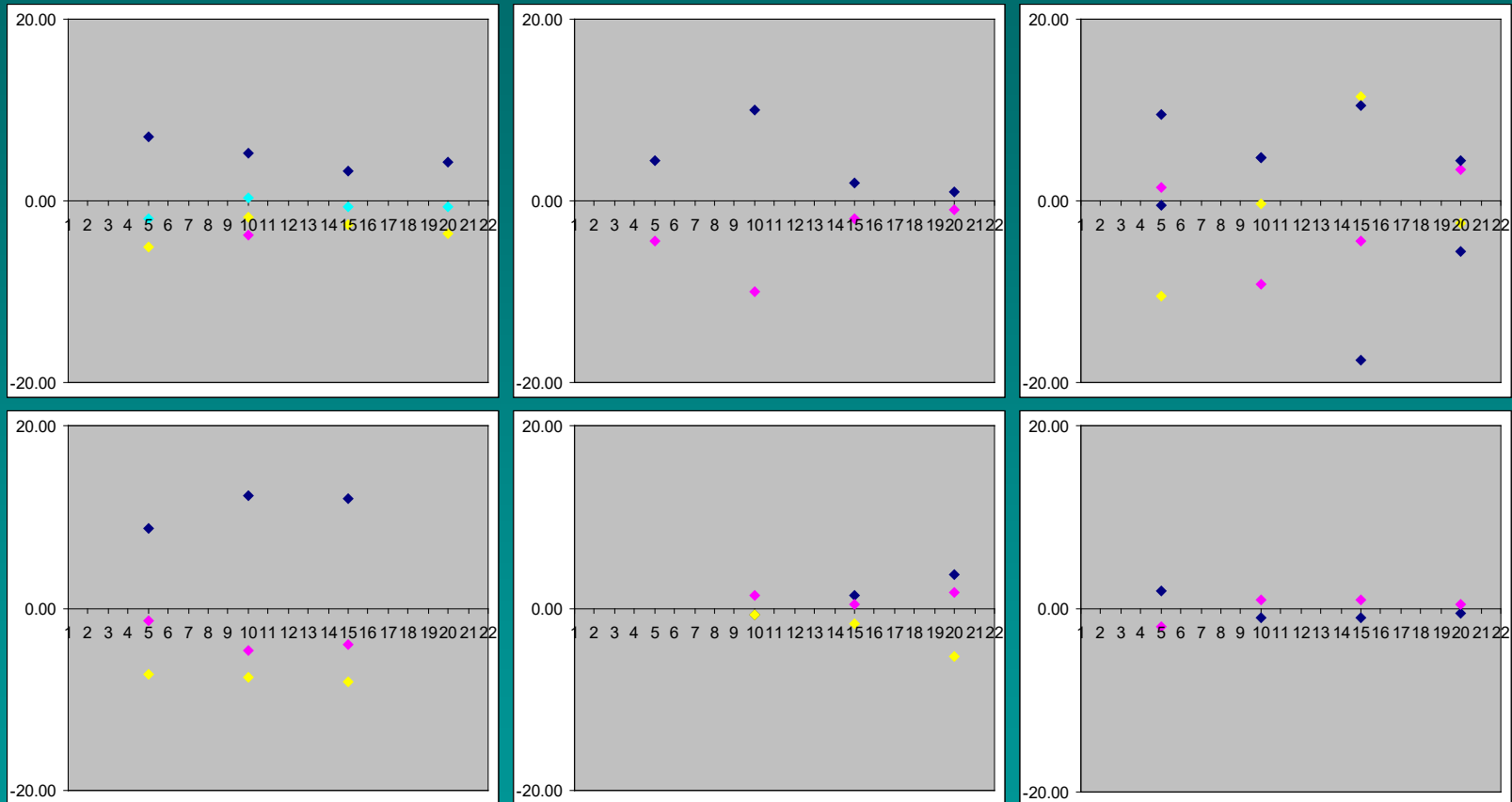


Pooling the raw TNRT profile data across subjects would produce an inaccurate picture with much larger variations in TNRTs due to the

- Differences in absolute levels
- Differences in levels between electrodes

Transforming the raw TNRT data

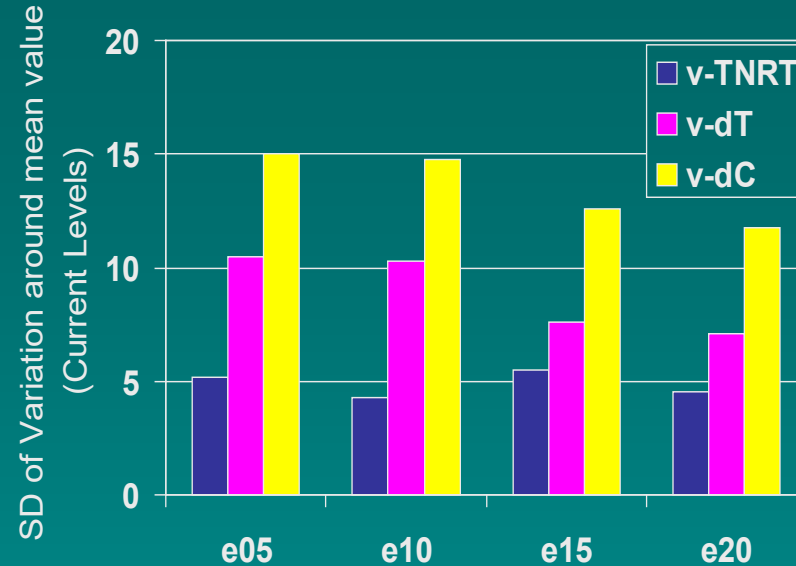
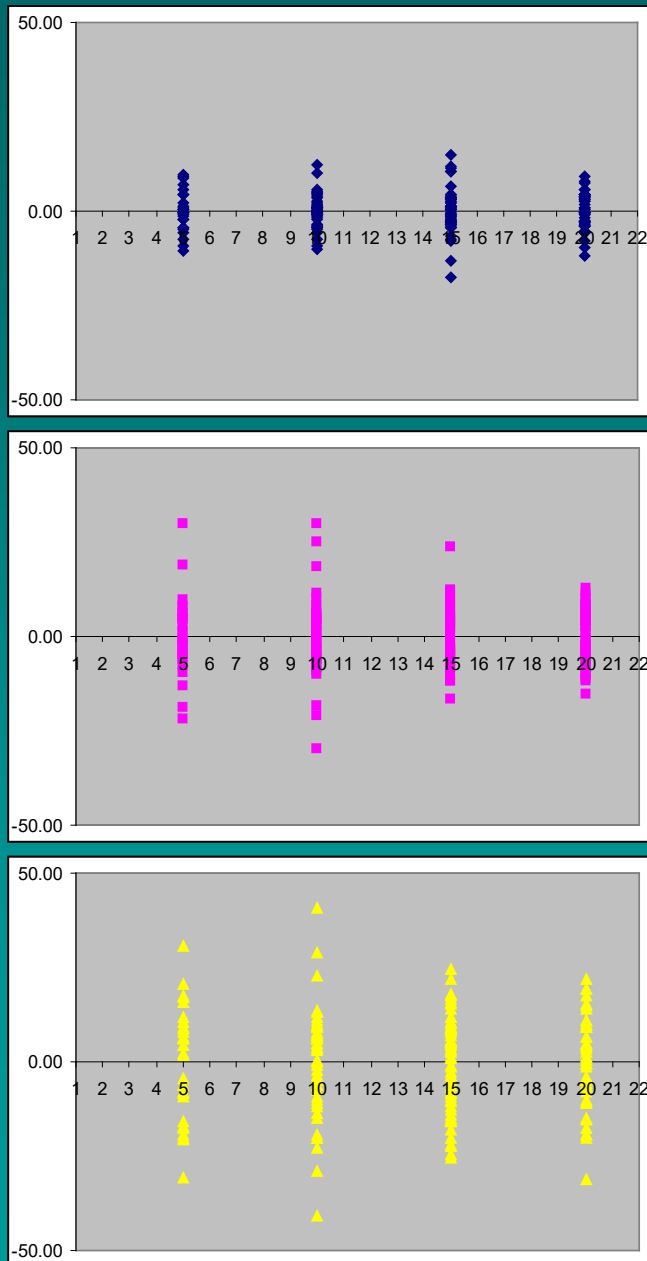
For each subject, the variations around the mean TNRT for each electrode were computed first.



This enables us to then pool the data across subjects, and also to compare the differences between electrodes.

The same was applied to the differences between TNRT and Map levels.

Variations around mean value

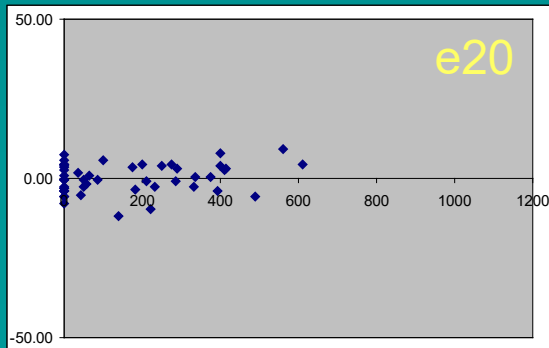
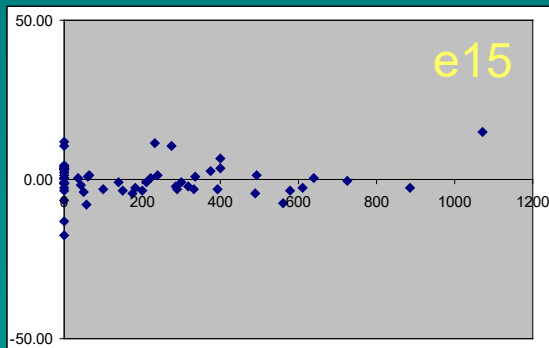
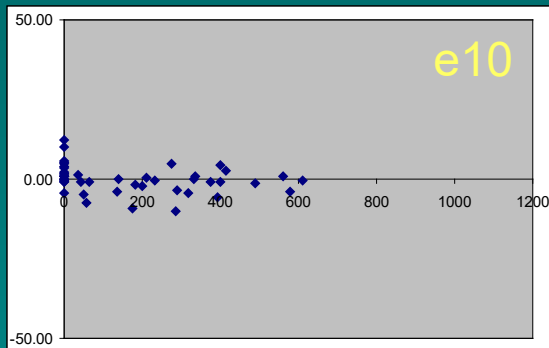
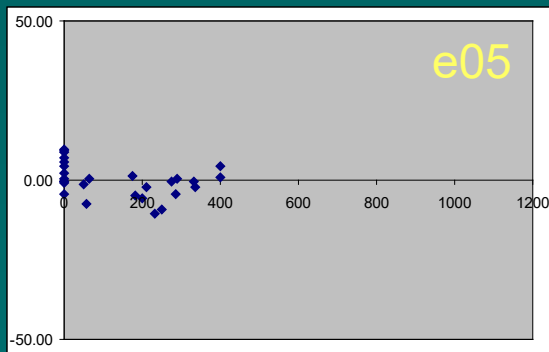


- ▶ Variation of TNRT around mean value is relatively small and similar across array.
- ▶ Variation of dT around mean value is larger, and diminishes towards apical end of array.
- ▶ Variation of dC around mean value is largest, also diminishing towards apex.

NB: All 3 plots on left use the same vertical scale

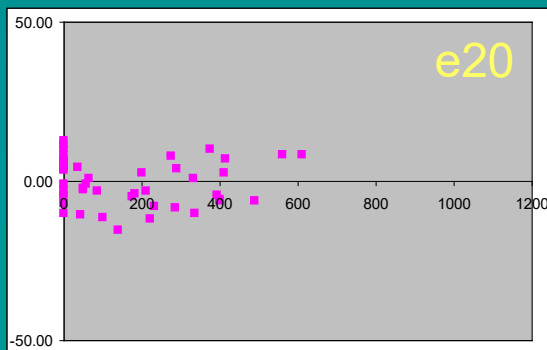
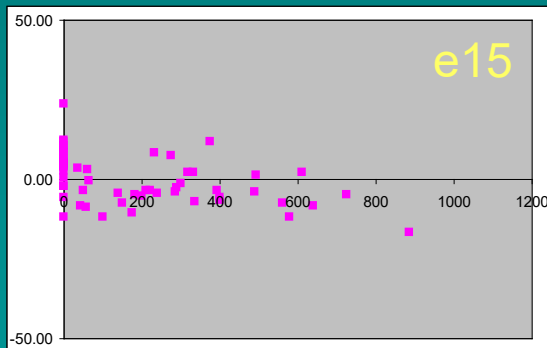
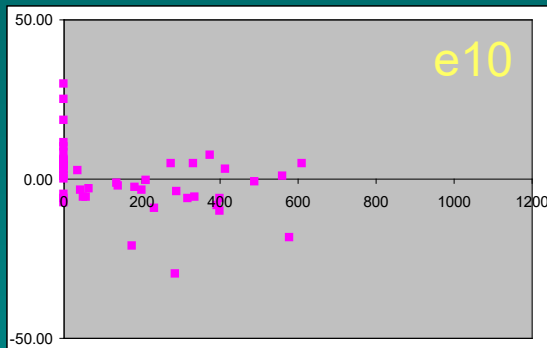
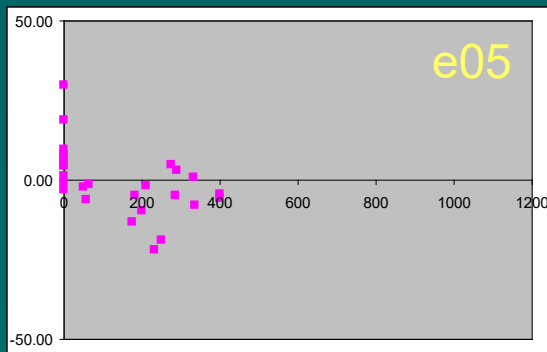
Variation over time: TNRT

- Variation around the mean TNRT value remains small over time
- Variations do not grow nor diminish over time
- Variation across the array appears to be similar



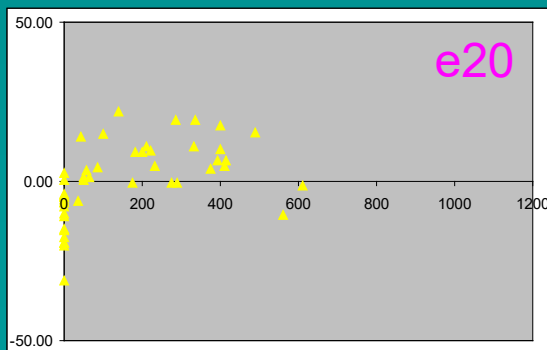
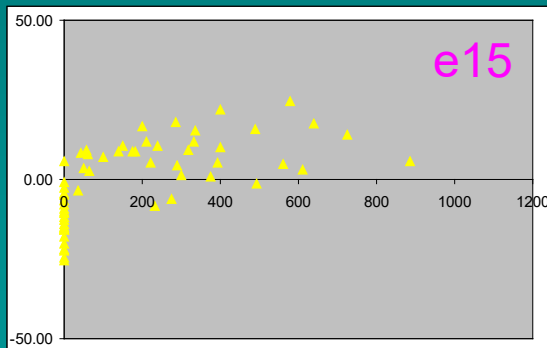
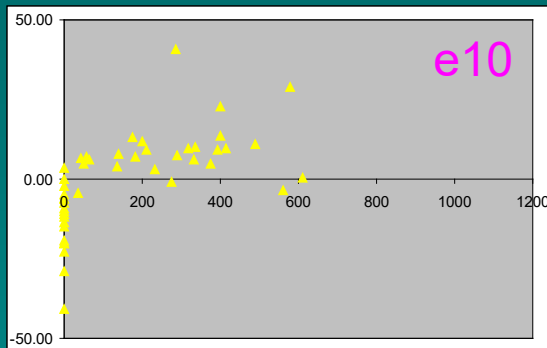
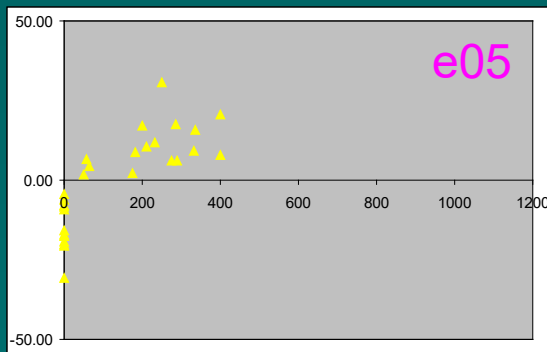
Variation over time: dT

- Variation around the mean dT is slightly larger at the beginning (initial fitting session)
- Variations diminish with time
- Variations are slightly less towards apical electrodes



Variation over time: dC

- Variation around the mean dC is largest at the beginning (initial fitting session)
- C levels typically underestimated at the beginning (dC values less than mean value)
- Variations diminish with time
- Variations are slightly less towards apical electrodes



Discussion

- TNRT profiles appear to be generally stable over time, and variations can be accounted for by measurement noise.
- Differences between TNRT and Map T & C levels show greater variations over time, mainly due to changes in the Map levels.
- Differences between TNRT and C-levels fluctuate more over time compared to differences with T-levels.
 - C-levels are more subjective in nature than T-levels, and tend to be more conservatively set in the initial fitting session.
- Slightly less variations towards apical electrodes probably due to lower pitch sounds being more pleasant and therefore less prone to changes in tolerance or mood of subjects (applies mainly to C-level).
- It is not possible to ascertain (from the data in this form) whether the larger variations in dT and dC are from particular individuals or not.
- Further analysis is planned to take into account the individual dT and dC "trajectories" over time.

Conclusions

- TNRT profiles can generally be regarded as stable over time.
- Changes in the relationship between TNRT and Map levels over time are mainly due to changes in the Map T & C levels.
- Changes in the behavioural Map T & C levels are difficult to predict, resulting in reduced accuracy when using the TNRT profile to predict the map profiles.
- Further analysis required to determine how variations over time of dT and dC may be accounted for on an individual basis
- At present, TNRT-based maps will still require manual optimization, particularly if we regard behavioural maps as the "gold standard".