

# Application of electrophysiological measurements in processor fitting; parametric fitting

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# Question

- Starting rehabilitation of a cochlear implant patient by assessing the T- and C-levels for 22 electrodes is quite cumbersome, particularly in children or those individuals who have little hearing experience at all.
- Can we simplify the procedure, make it more patient-friendly, *e.g.* by using electrophysiological data, and / or by using speech stimuli ?

# Approach

- The literature (Abbas, Brown) shows that the correlation between T-levels and NRT-thresholds is weak.
- However, the profile of the NRT-thresholds across the electrode array may be indicative of the profile of the T- and C-levels.
- Take the NRT profile and adjust the overall level of the profile to threshold and comfort level using life speech.

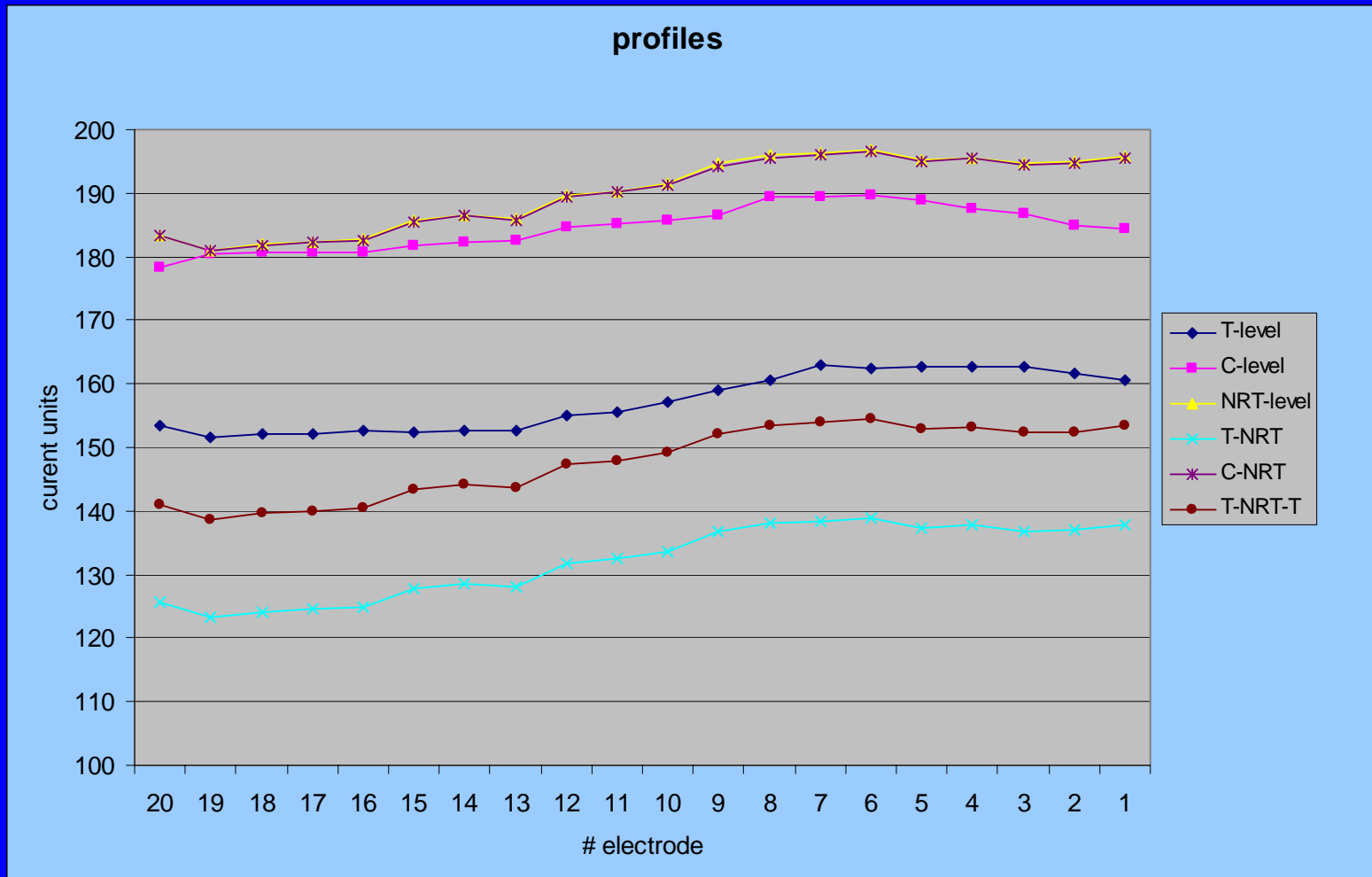
# Methods

- Adult subjects
- SPEAK strategy
- Post-operative NRT measurements
- NRT measurements at electrodes 3-22
- Over-all adjustment of NRT profile to T- and C-levels using life voice  $>$  NRT-MAP
- Speech reception tested with CVC words
- Speech test immediately after assessing NRT-MAP and after 2 weeks of optional use of the NRT-MAP

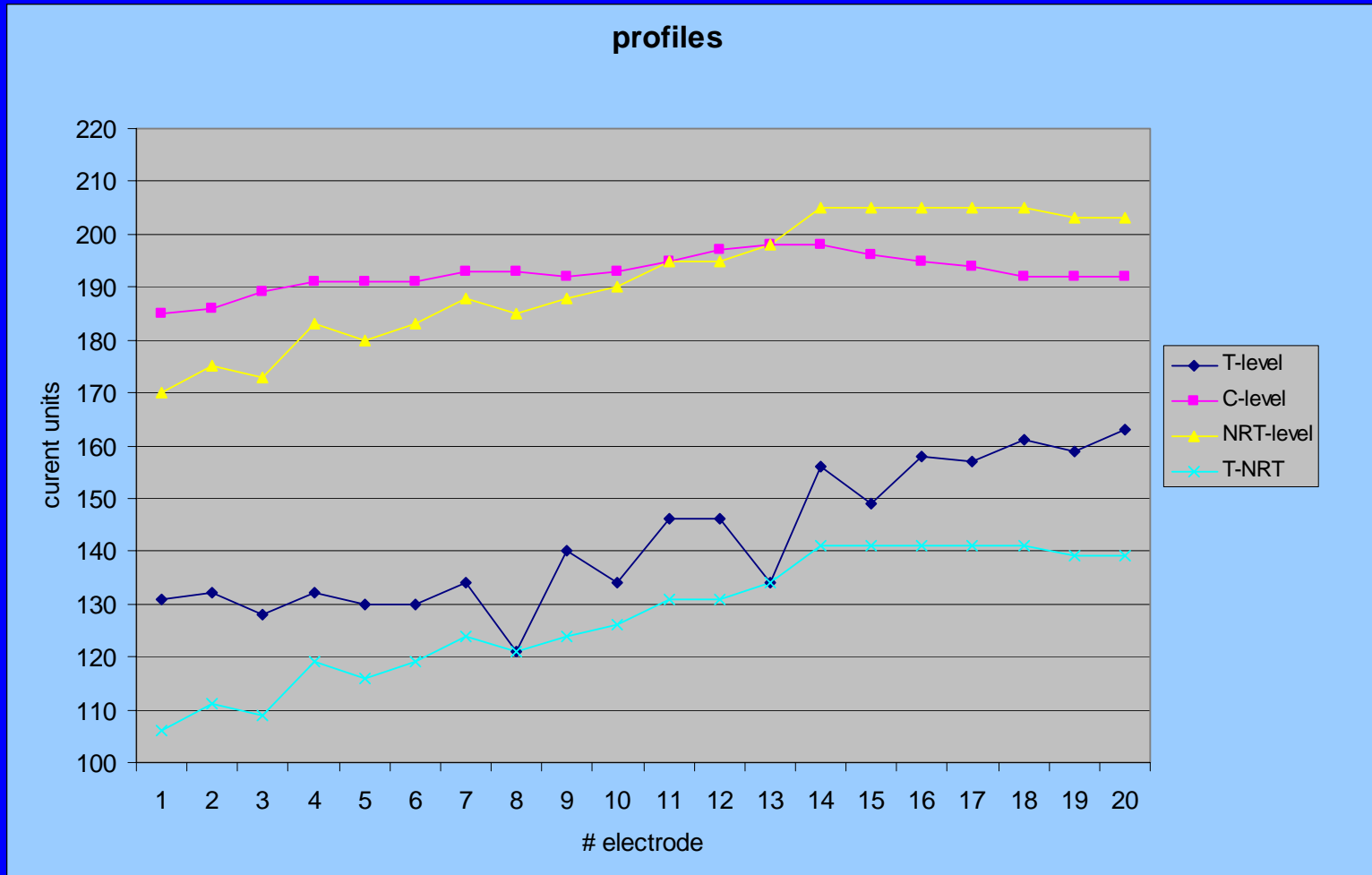
# Results 1

- Postoperatively, we found NRT thresholds at all 20 electrodes in 13 < 27 subjects (48%).
- The result of the Cochlear field study is similar: 65 < 147 (44%).
- T-NRT, the T-levels assessed by adjusting the overall level of the NRT-profile using life voice, appeared to be much lower than the conventionally determined T-levels.

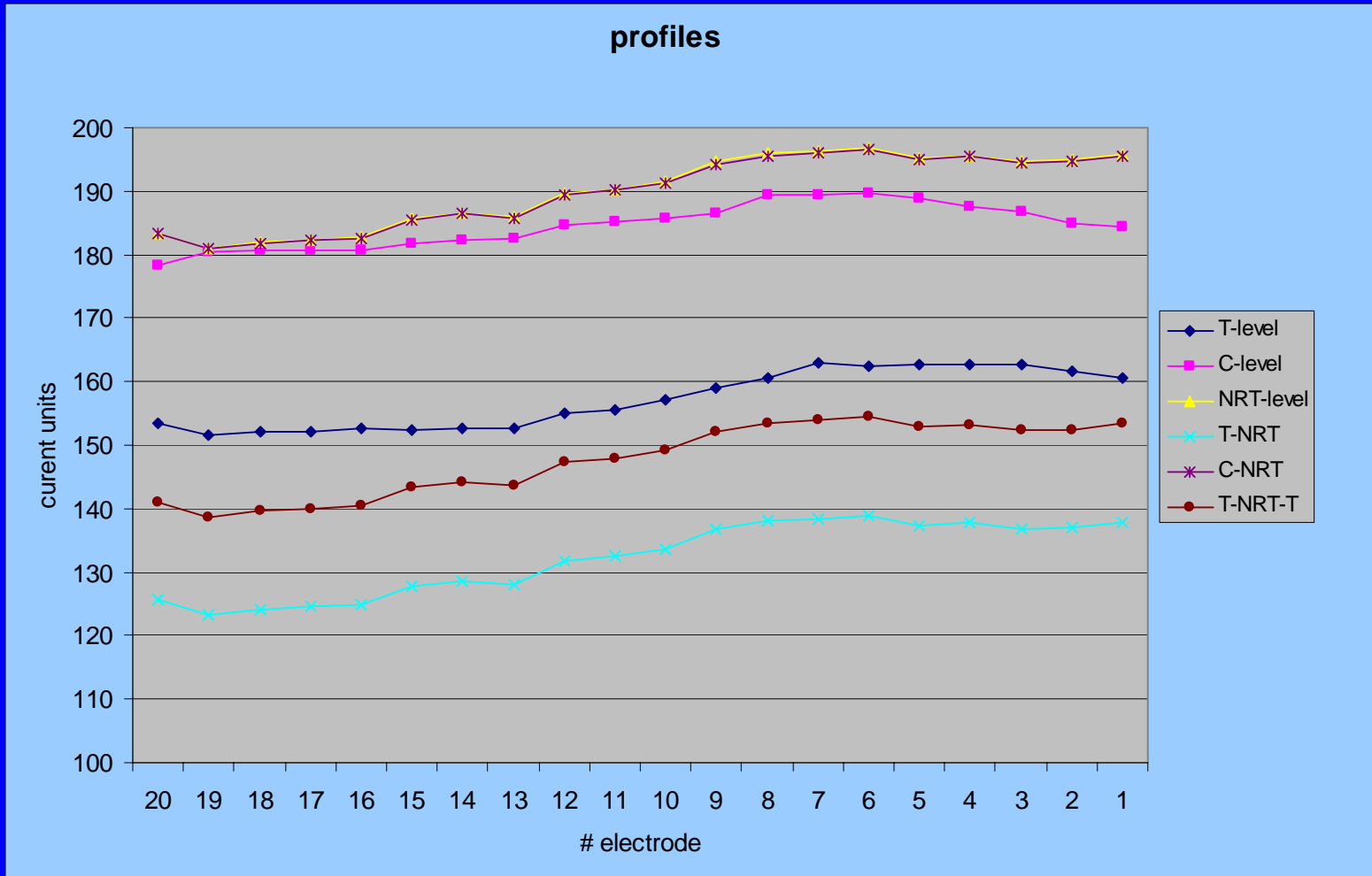
# Comparison of NRT-thresholds to T- and C- levels



# NRT profile touching NRT-levels



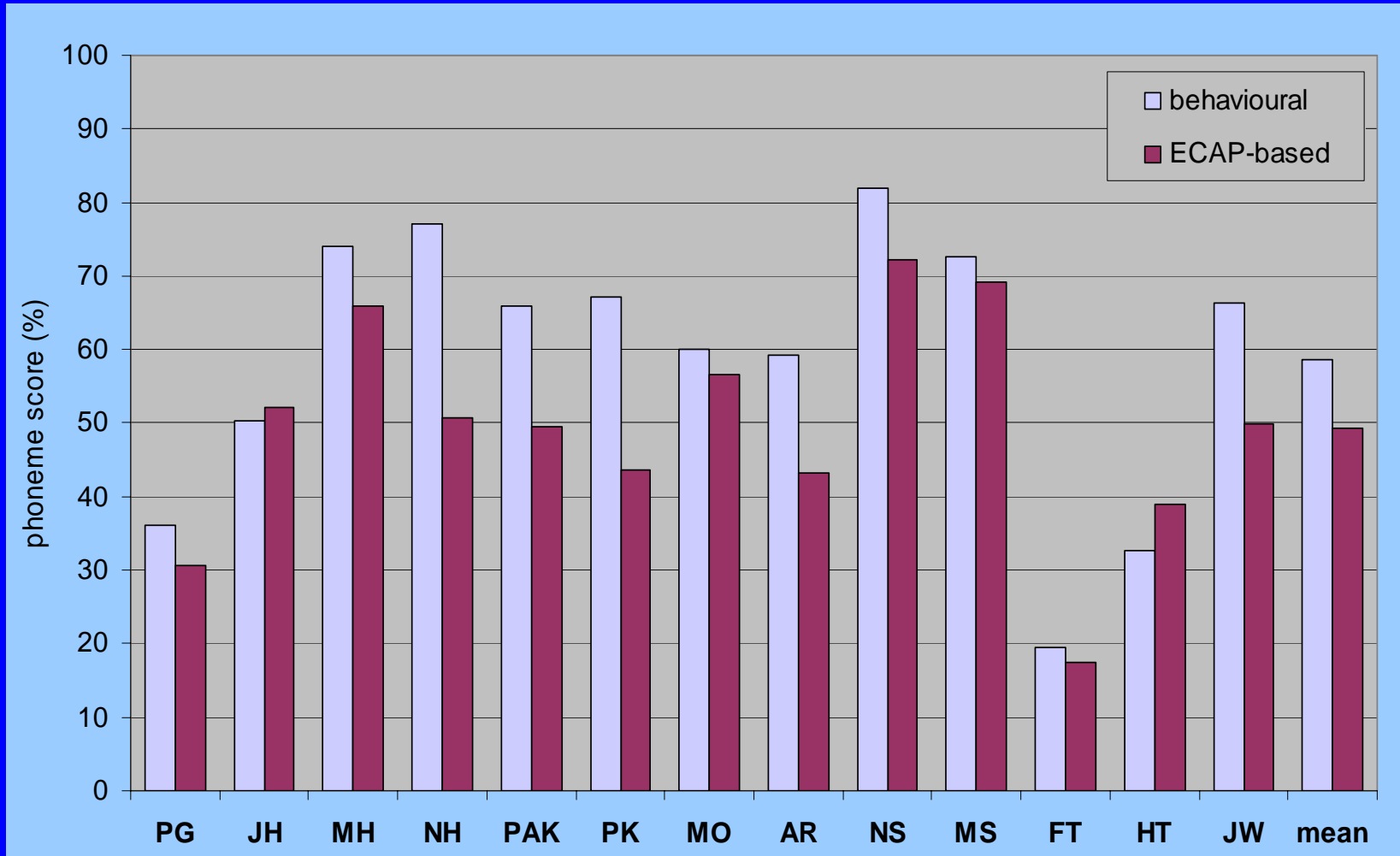
# Comparison of NRT-thresholds to T- and C- levels



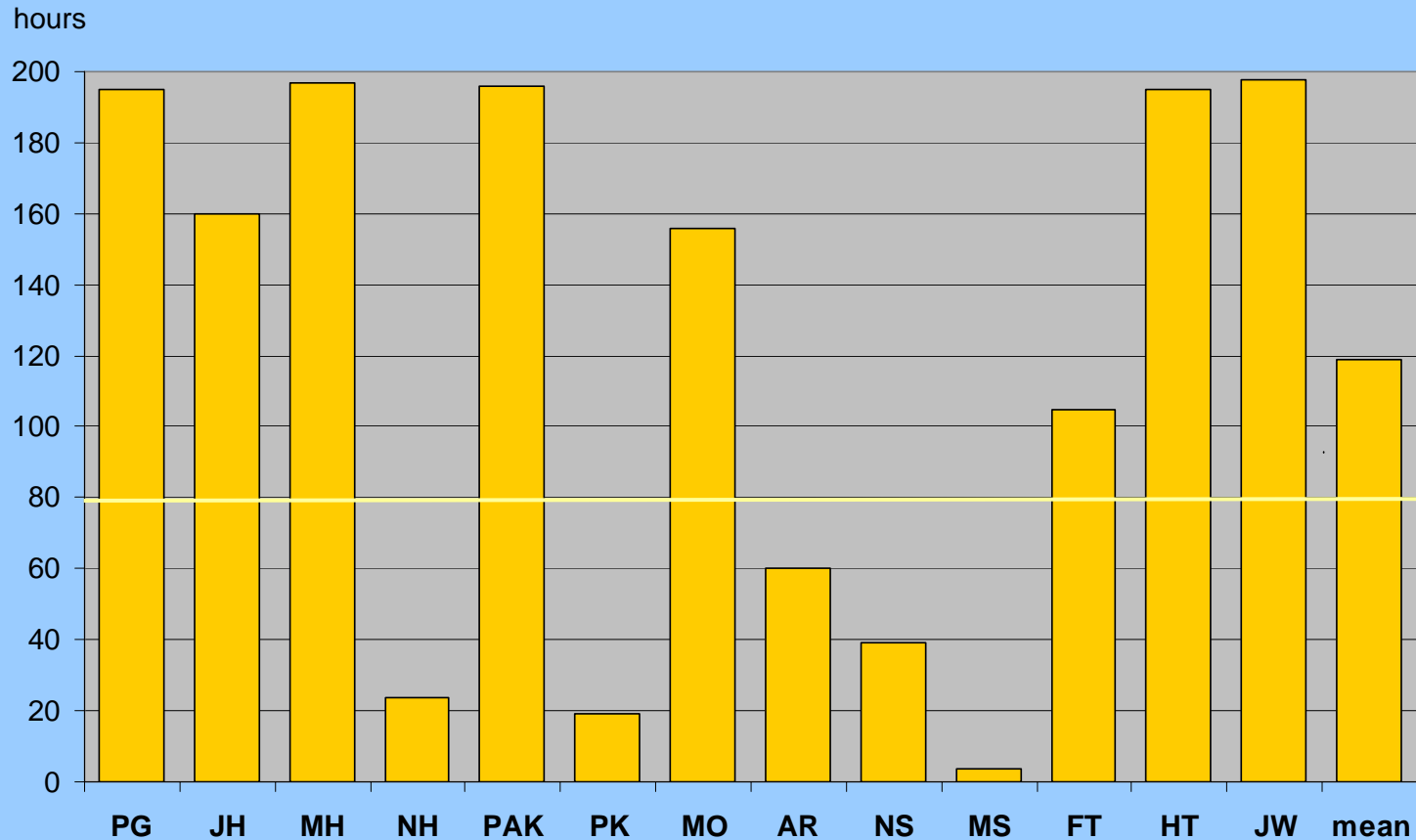
# Results 2

- The T-NRT levels are much lower than the conventional T-levels.
- The C-NRT levels are somewhat higher than the conventional C-levels.
- Thus, the dynamic range of the NRT MAP is about twice the range of the conventional MAP.
- For 1/3 the lower T-NRT levels may be explained by the assumption of response of the 1<sup>st</sup> electrode.
- For 2/3 the lower T-NRT levels may be explained by spatial/frequency-band integration of impulse rate.

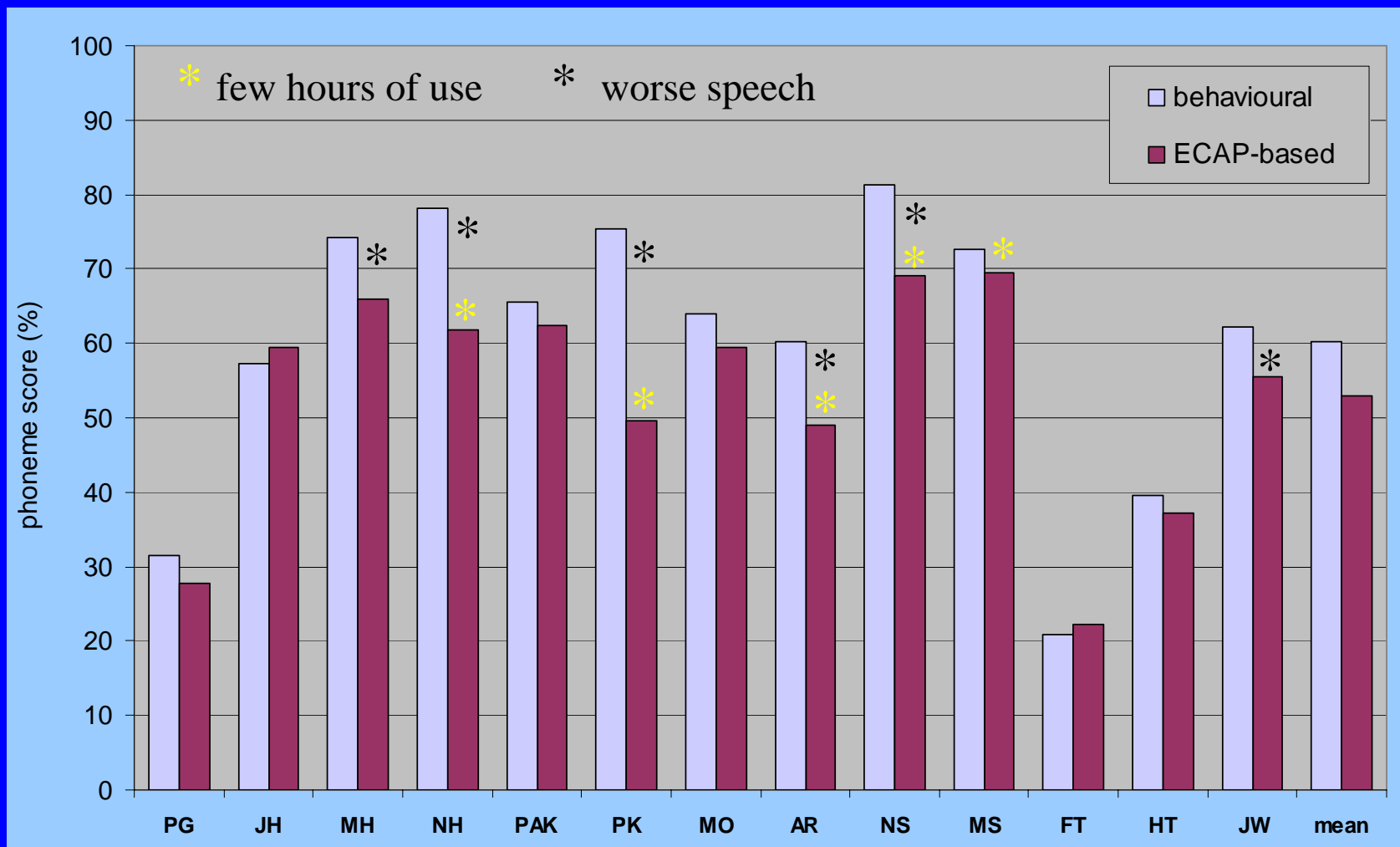
# CVC scores with behavioural and NRT-based MAPS, 1<sup>st</sup> session



# Hours of use of NRT-based MAP



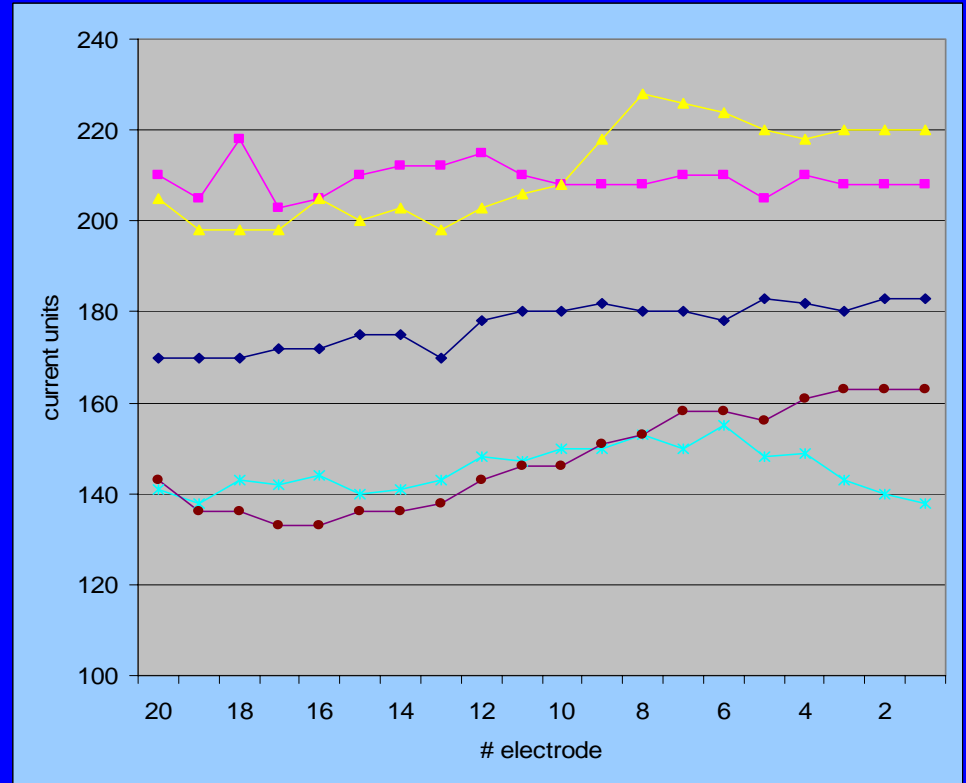
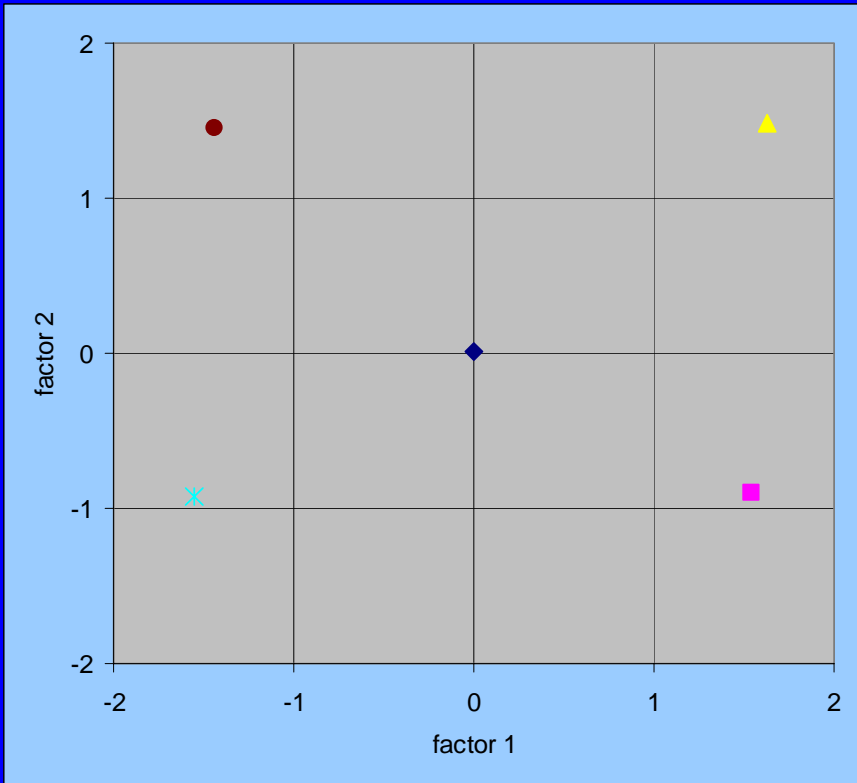
# CVC scores with behavioural and ECAP based MAPS, 2<sup>nd</sup> session



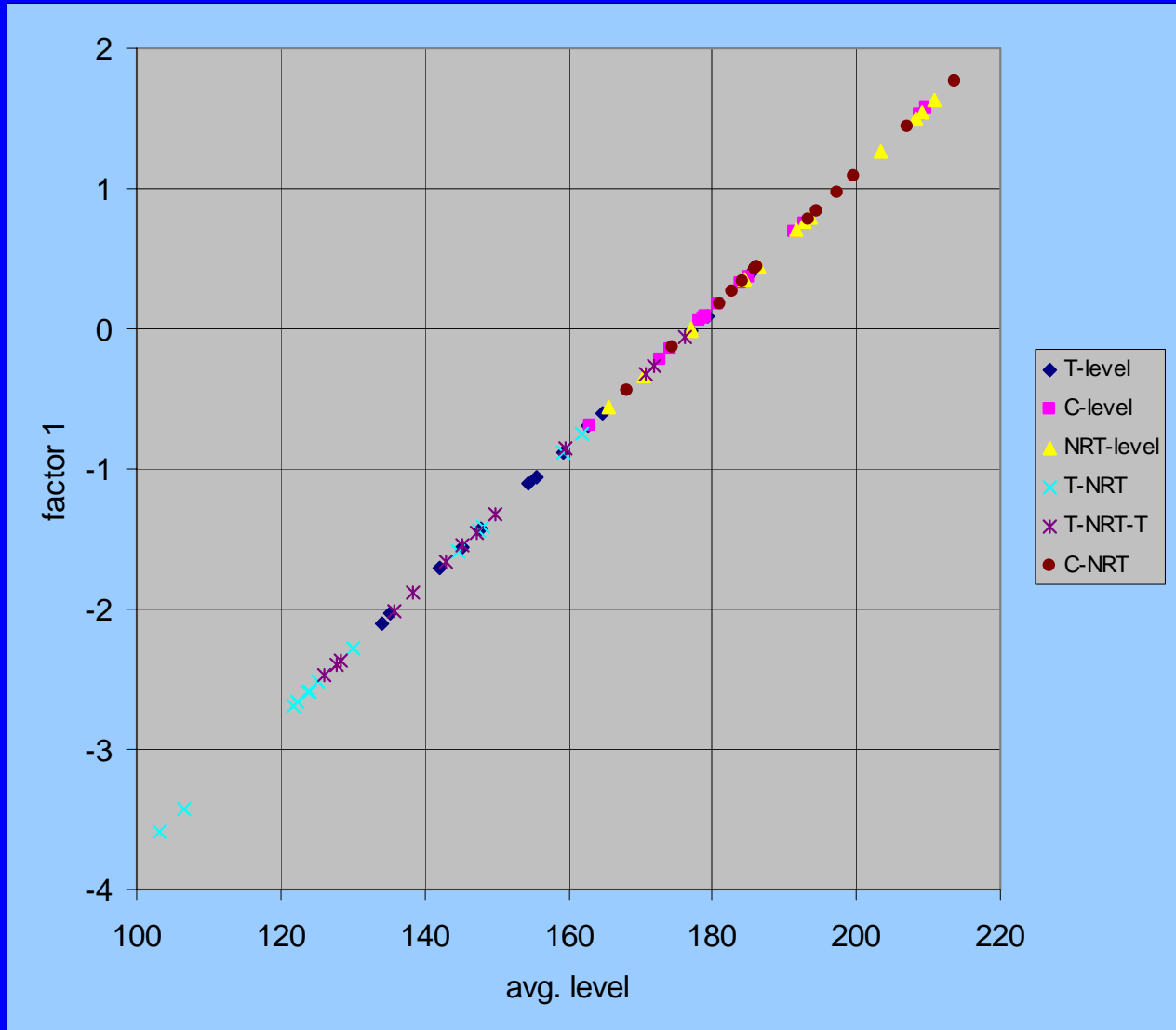
# Results 3

- On average, phoneme perception is little (7%) affected by a large decrease in overall T-levels and some upward shift of the overall C-levels.
- The MAP may change considerably without affecting speech reception.
- The results show marked intersubject variability; some subjects perform just as well with the NRT-based map, some perform up to 25% worse.
- WHY ?

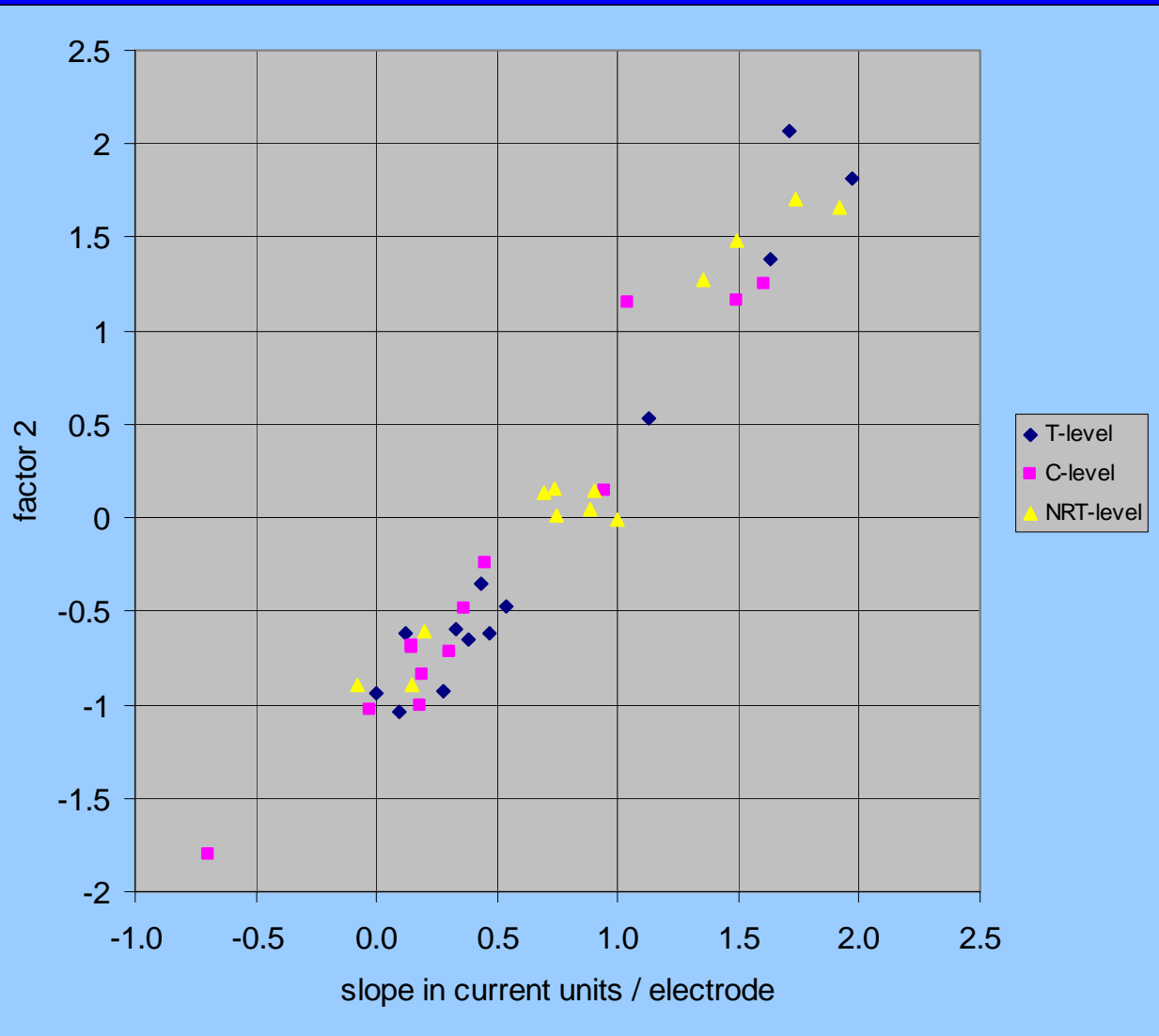
# Examples of individual profiles displayed in terms of the two factors



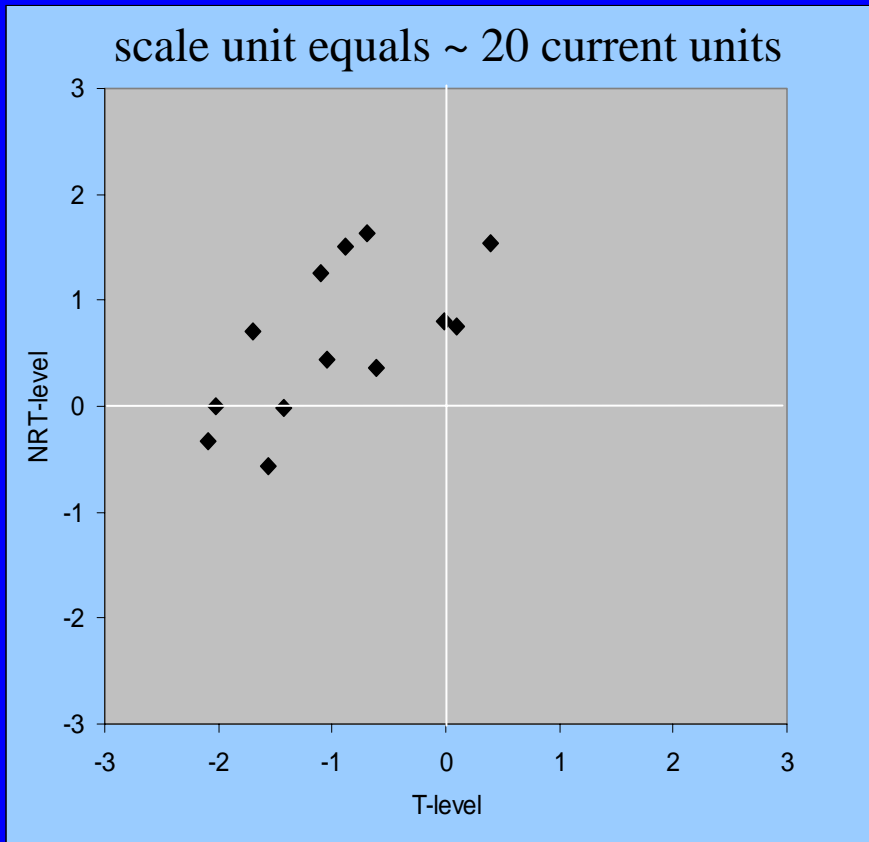
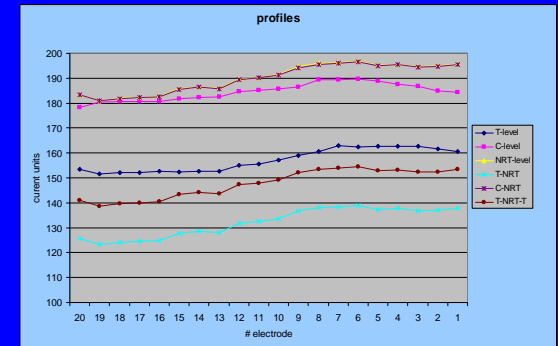
# Profile factor 1: overall level



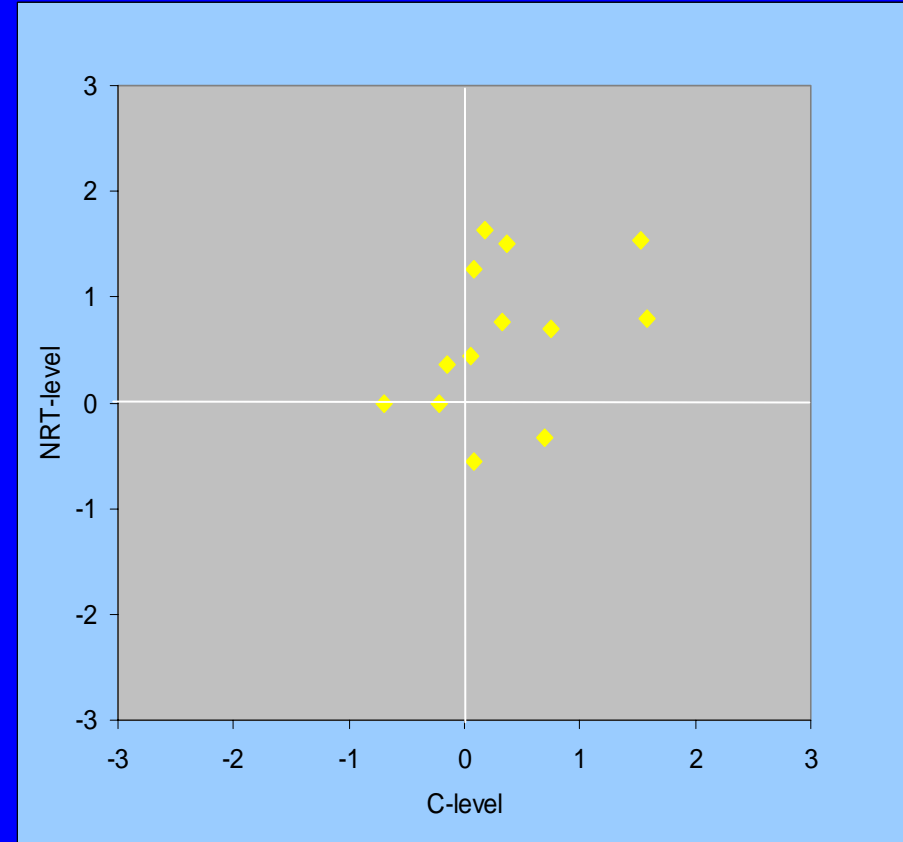
# Profile factor 2: slope



# Correlation between overall T-, C- and NRT-levels

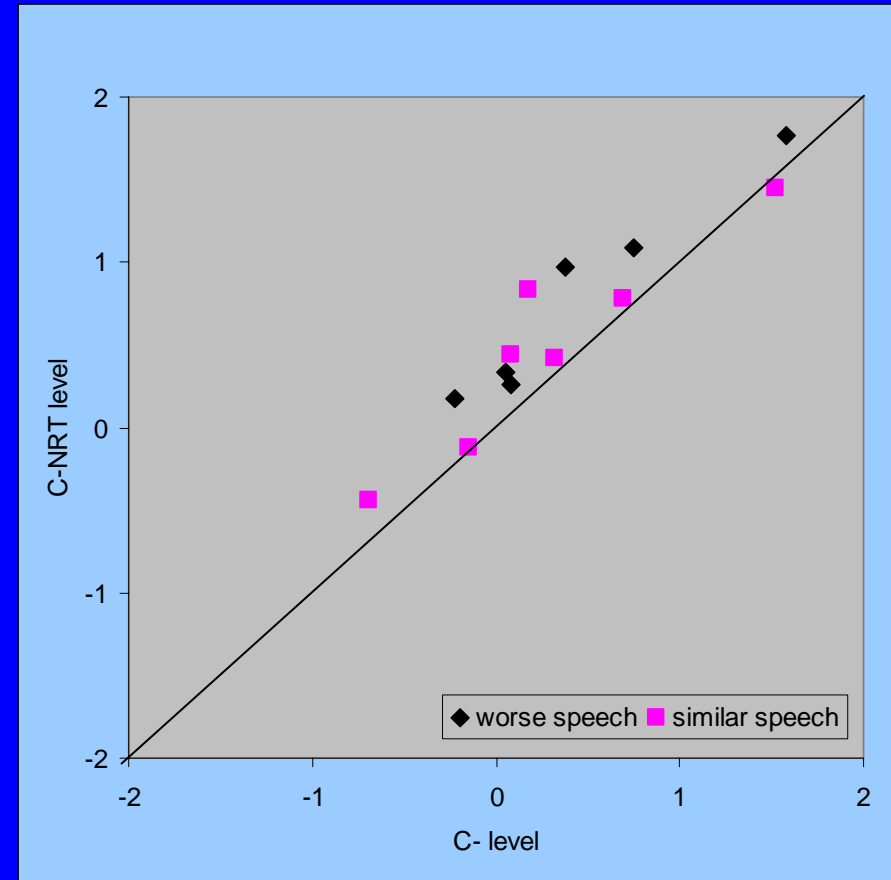
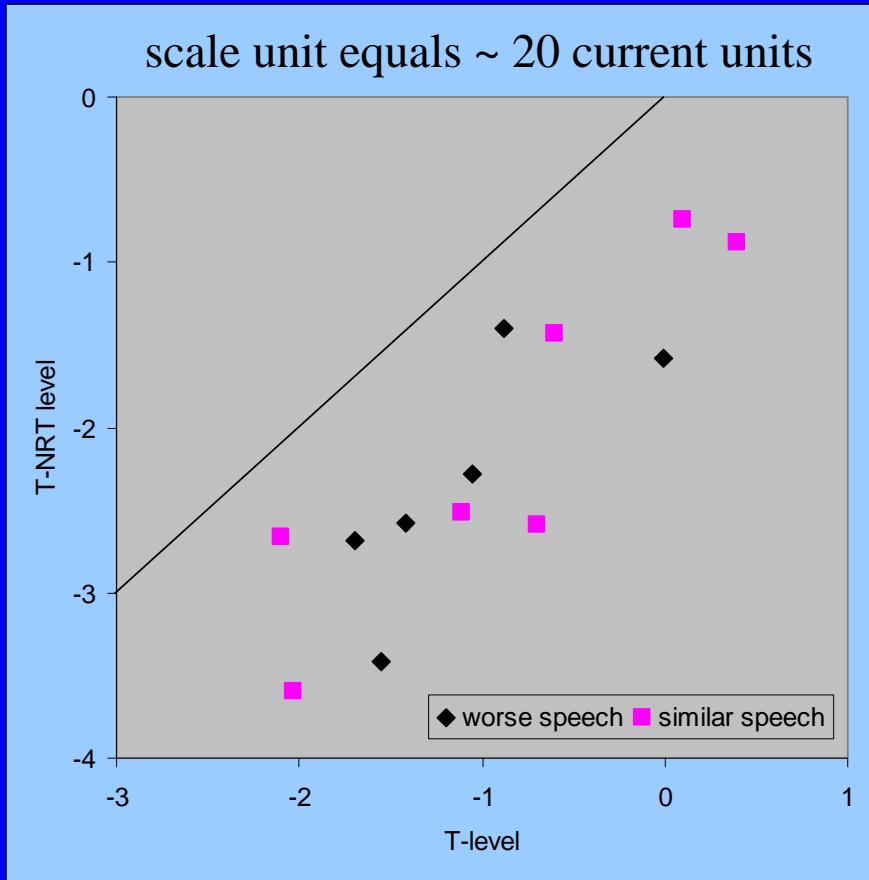
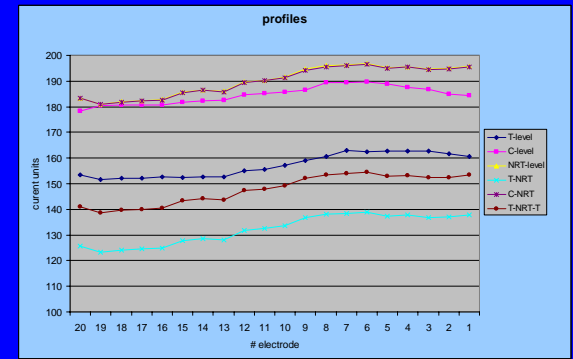


Corr. coeff = 0.64

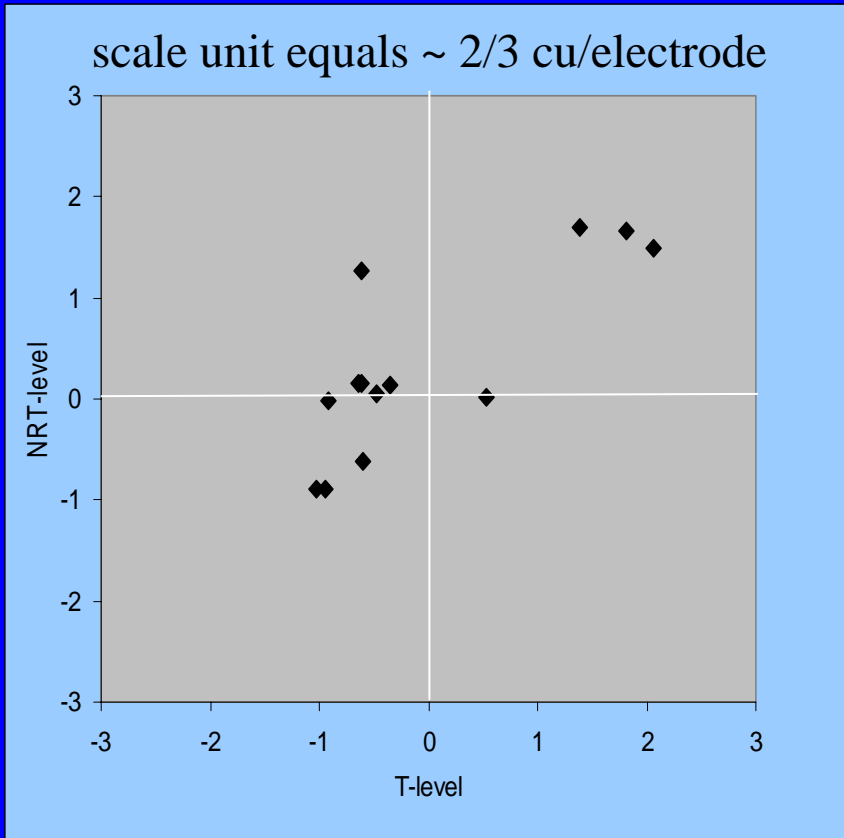
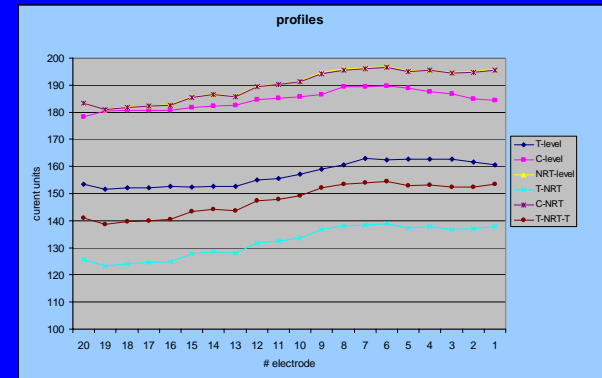


Corr. coeff = 0.39

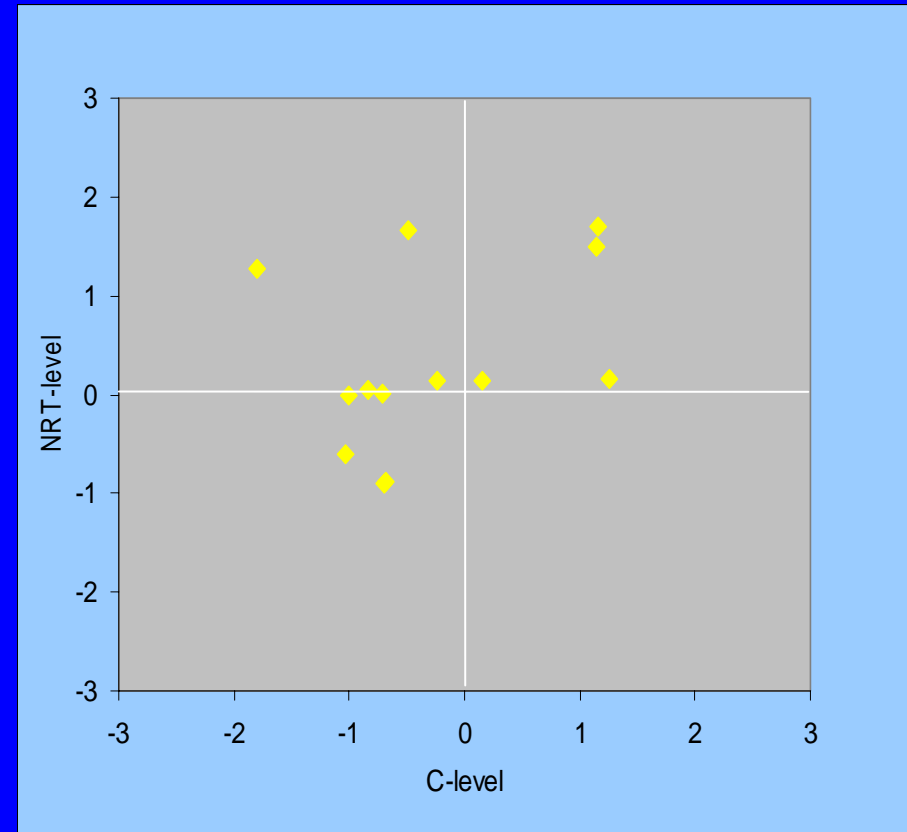
# Speech perception *re* difference in overall level



# Correlation between tilts in T-, C- and NRT-levels

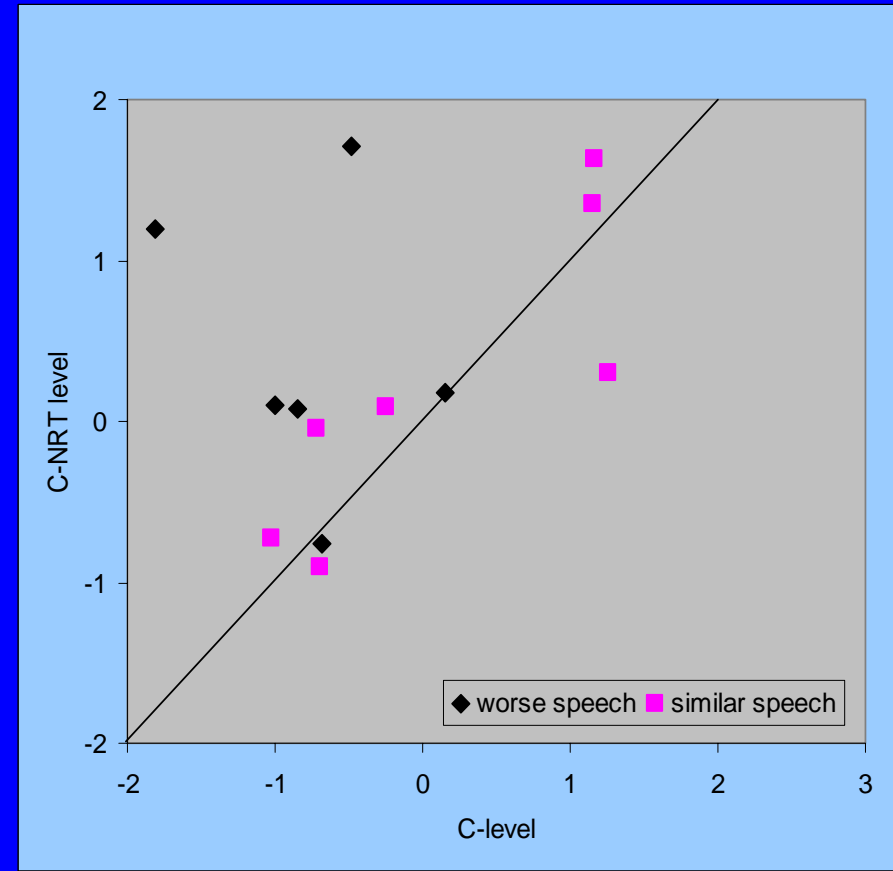
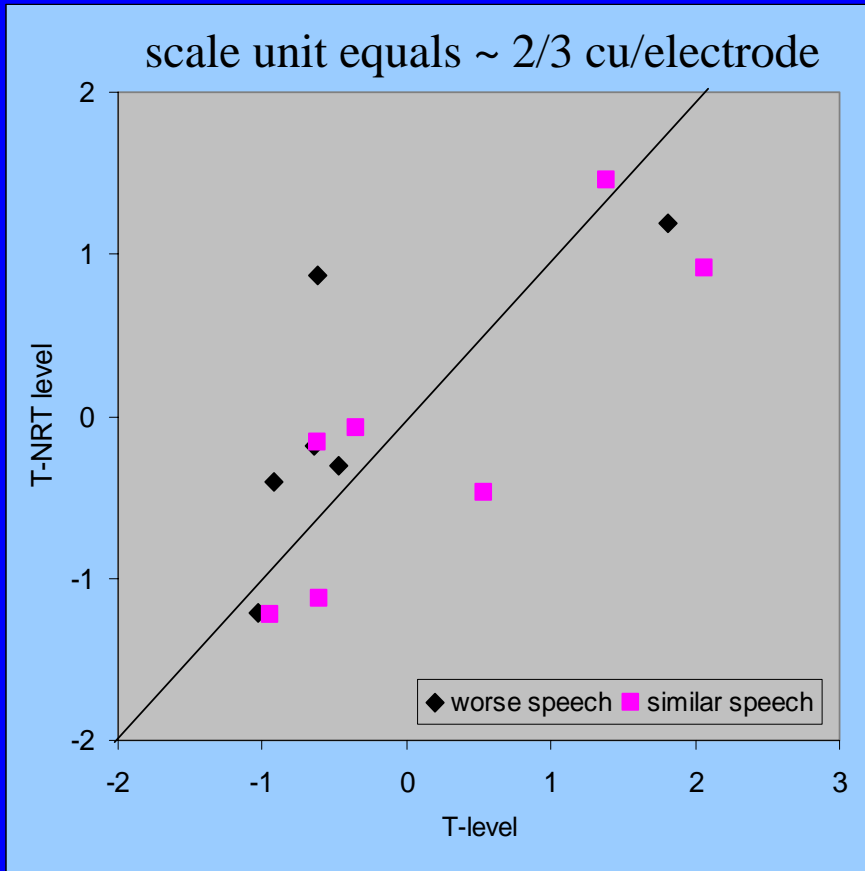
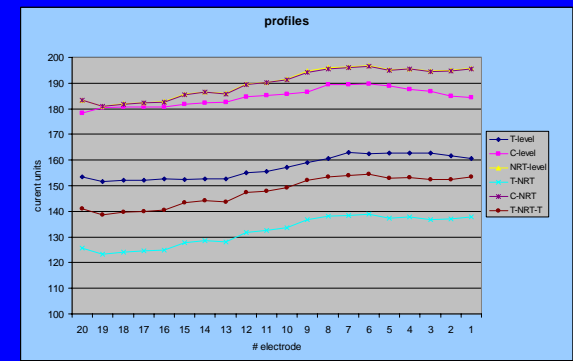


Corr. coeff = 0.80

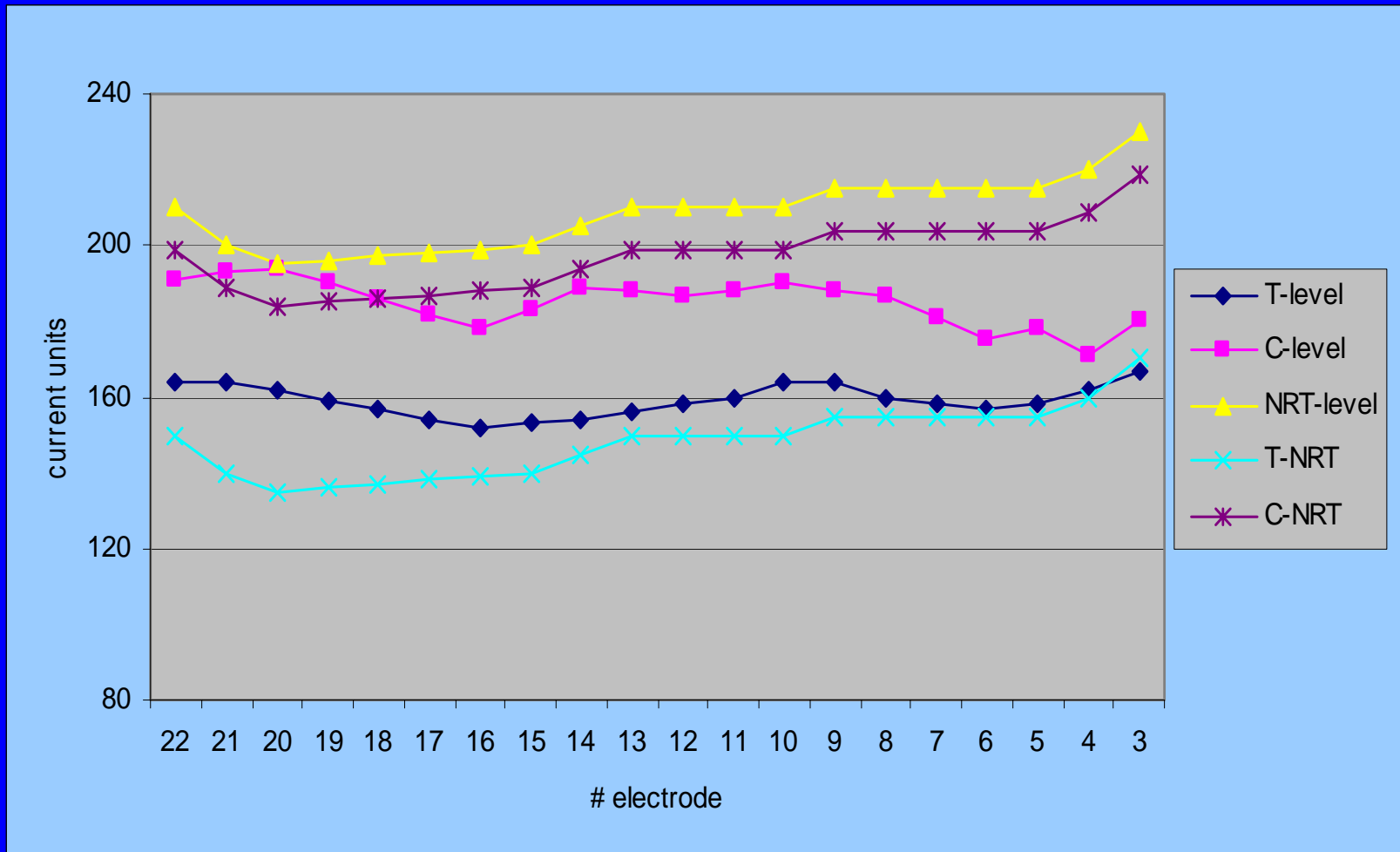


Corr. coeff = 0.36

# Speech perception *re* difference in tilt



# Individual example of poor speech perception



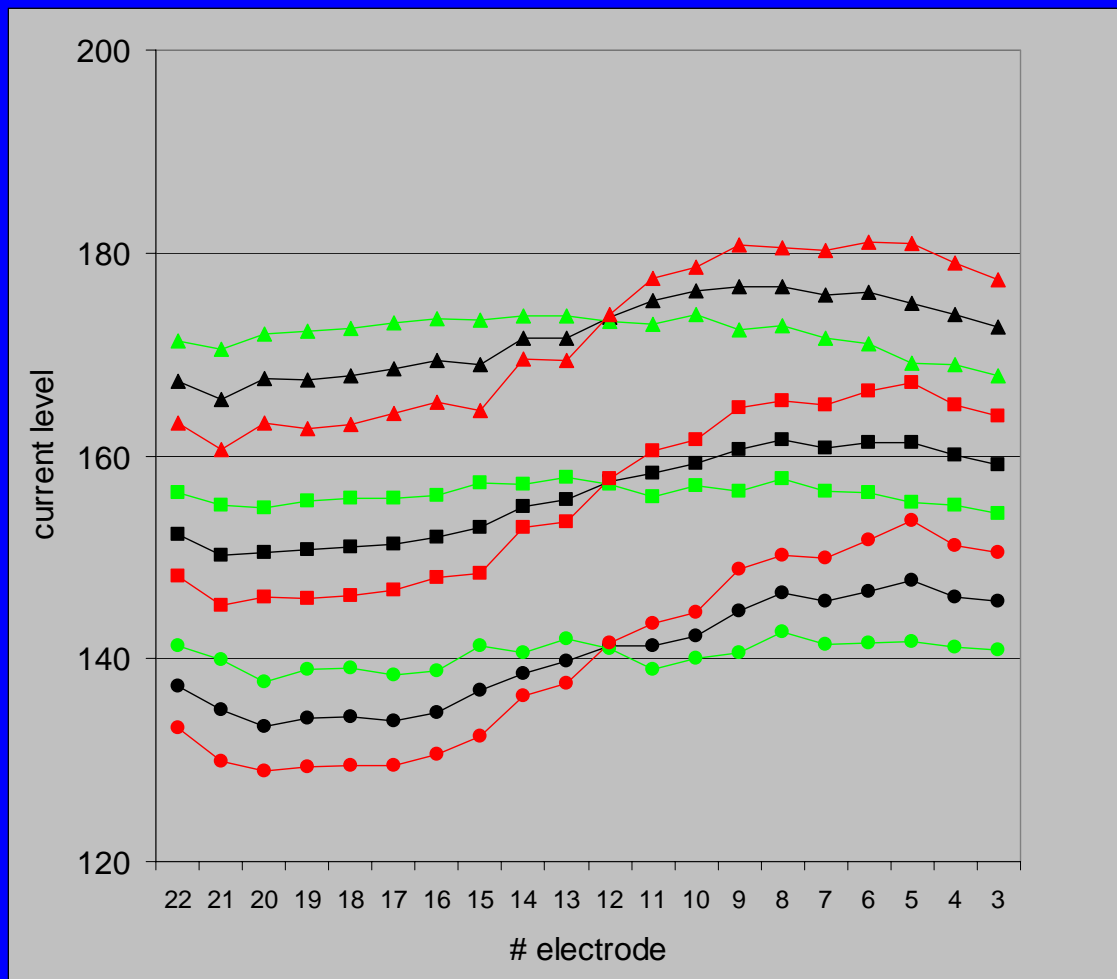
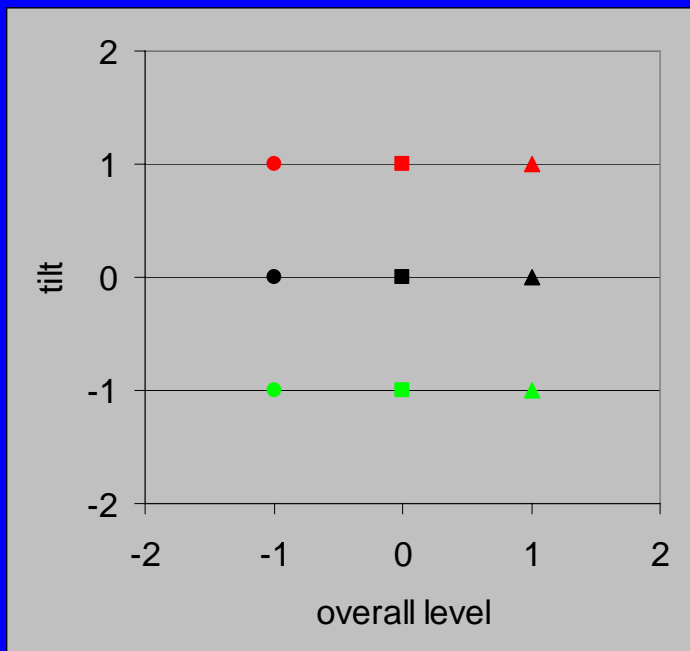
# Results 4

- The T-, C- and NRT-profiles can be described by only two factors: overall level and tilt.
- For *overall level* the correlation between T-level and NRT threshold is weak (0.64), for C-level and NRT threshold it is poor (0.39).
- For *tilt* the correlation between T-level and NRT threshold is satisfactory (0.80), for C-level and NRT threshold it is poor (0.36).

# Results 5

- NRT predicts the T-profile accurately but this may be unimportant to speech perception.
- NRT does not accurately predict the C-profile whereas the C-profile may be important to speech perception. Phoneme perception decreases with a marked increase in the tilt of the C-level profiles.
- However, these results may have been affected considerably by habituation to the initial MAP.
- Acceptance of stronger high-frequency stimulation might favour speech perception.

# Parametric fitting



# An implementation of parametric fitting

