IERASG 2019
Sydney Australia

Meeting Summary

Bob Burkard

Thursday 4 July 2019

Preconference Presentations:

Andrew Dimitrijevic: “Introduction to EEG Analysis”

David McAlpine: “Using fNIRS to Map Auditory Cortical Function”

Laurence Bruggeman: “Using Eye Tracking & Pupillometry”

Rebecca Holt & Joaquin Valderrama: “Examining Sentence-Level Processing using ERPs”

Fabrice Bardy: “Introducing Machine Learning for EEG Analysis”

Invited Presentations:

Hallowell Davis Lecture: Linda Hood: "Physiology and the Audiogram- A Love-Hate Relationship"

Guest Lecture 2: John Durrant: "In Memoriam Roger Thornton"

Guest Lecture 3: Phillip Gilley: "Stimulus Expectancy modulates Speech Discrimination Processing in Infants and children"

Guest Lecture 4: Robert Burkard: "The Auditory Brainstem Response (ABR) Across Species: Sometimes it is Not Just About the Human Condition"

Panel 1: Imaging (D. McPherson, moderator; P. Gilley, J. Zenin, C.M. McMahon, A. Dimitrijevic, P. Sowman)

Panel 2: AEPs/Clinical tools (B. Cone, moderator; K. Uhler, R., Burkard, S. Purdy, F. Bardy, S. Small, S. Bell)

Panel 3: VEMPs (R. Burkard, moderator; A. Beynon, R. Delgado, C. Fowler, G. Lightfoot)

Linda Hood: Hal Davis Lecture: Auditory neuropathy Cross check principle Genetics Gorilla, Sea lion– no ABR/AR, present CM/OAE, mixed audiogram, poor speech in noise– not a consistent clinical presentation; Charcot-Marie-Tooth, OTOF, temperature sensitivity, good prediction of who will do well with a CI, neuromaturation, Corticals

John Durrant: Roger Thornton Memorial – ABR latency/amplitude across stimulus manipulations, chair of IERASG, nonlinearities, corticals, ABR, MLS, modeling, OAEs

Phillip Gilley: Stimulus expectancy- time/frequency analysis in EEG during development. Review from single unit responses to EEG as oscillatory activity to time locked responses. High frequency oscillations- short latency, lower level of processing. Later is lower frequency- related to higher level of processing- more cognitive. Top-down and bottom-up processes are comodulatory. Useful for looking at development of speech perception- MMR (in kids can be positive). ACC/MMR- sleep an issue

Bob Burkard: Cross-species ABR- stimulus manipulations

Panel Discussions

Imaging: Standardization needed; EEG is a great imaging modality; DTI "that is correct; I agree", connectivity analysis, bumpology; EEG bands; machine learning is an important component in patient care; health care costs; public health; different health care models

AEPs: ASSR and CAEP in the clinic, clinical relevance, EBP, applications differ across country, limited acceptance of ASSR, bench to bedside delay, practice guidelines, behavioral hearing loss is the gold standard; speech ABR, compare with perceptual measures, add imaging to understand APD.

VEMPs: motion sickness, SCD, MD, CI and vestibular function, dizziness, perception, mild cognitive impairment

Submitted Presentations#:

Podium: 73

Poster: 49

These numbers, in this slide and those in slides 10-13, do not necessarily reflect changes to the program made at the time of the meeting, or as the meeting approached)

Student Podium Session

Adjekum, R	Frequency specificity of narrow-band LS-Chirps verus 2-1-2 linear-gated tones: acoustic spectral analyses
Abrahamse, R	Auditory Discrimination in Prelingually Deaf Early Implanted Cochlear Implant Users: an ERP Study
Bhat, PJ	Pitch coding in Vocalists and Non Musicians to Carnatic Music stimuli : An AEP study
Chan, S	The acoustic change complex elicited to iterated ripple noise, a temporal pitch percept, in infants and adults with normal hearing
Dillard, L	The use of auditory evoked responses in measuring ototoxic damage from treatment of prevalent diseases: A systematic review & meta-analysis
Faundez, JP	Assessing neural ITD processing in normal hearing adults
Kwak, C	A Relation between Speech Degradation and Listening Effort under Reverberated and Noisy Environments
Moffat, R	Mapping emotional prosody processing in normal and cochlear implant listeners with fNIRS: a pilot study
Publius, A	Intrasession and Intersession Test-retest Reliability of Onset, Offset, Peak latencies, Amplitude and Area of Speech evoked P300
Salcic, A	Event-related potentials (ERPs) reveal atypical processing of ungrammatical sentences in adults with dyslexia
Vanthornhout, J	Objective speech audiometry through brain response classification
Puyan, A (TBC)	A Study of Combined Use of P300 and MMSE in Evaluation of Cognitive Functions in Patients with Hearing Loss

Students:

Spectral analyses- chirps/NB tones- transducers appear to be linear systems; chirp broader

Discrim/CI/ERP-tones/syllables- P3 related to speech perception and duration of deafness

Pitch coding AEP **Carnatic music** (S. India) musicians/non-musicians-FFR- musicians differed

ACC/iterated rippled noise/infants/adults: infants fewer ACC responses; less change w/#its

AEPs/Ototoxicity-systematic review/meta analysis; **malaria/HIV/TB/Cancer**: DPOAEs most

ITD- IPM-FR 40 Hz SAM- IPD switches ear by ~6 Hz, IID-EEG (interaural phase)- no effect IID

Listening Effort/noise/reverberation: N400 prolonged w/ reverb not noise

fNIRS: **emotional prosody**- The orange man- behavioral measures- acoustic differences

Speech P3- **test retest reliability** (intra- and inter-session); amplitude/area most reliable

ERPs in sentence processing **in dyslexia P600 reading-** much smaller/later in dyslexics

Speech detection using **EEG**- convolution approach- varying SNR- worse w/lower SNR

P3 MMSE MOCA Cognitive function and aging longer P3- poorer cognitive function

Posters

OAEs not changed post fMRI
BC ABRs
ASSR to speech-like chirp
TEOAEs to contralateral ear occlusion
Monte Carlo simulations/bootstrapping
False positive rates and multiple testing
FFR/voice pitch/Mandarin
ABR & tinnitus duration
CI & Vestibular function
ASSR/AAC MLD
Spatial release of masking
ASSR- include higher harmonics
N-back paradigm
Multitalker babble and informational masking
ACC in the blind
Charcot-Marie-Tooth
Hearing aids & Speech ABR

Countries (first author, submitted)*:

United Kingdom: 9 (12)
Australia: 10 (7)
Russia: 0 (1)
Ukraine: 1 (0)
Germany: 7 (7)
Brazil: 10 (7)
The Netherlands: 5 (4)
United States: 20 (16)
Korea: 20 (18)
Poland: 2 (16)
Spain: 1 (0)
Belgium: 4 (8)
Canada: 7 (5)
New Zealand: 3 (1)
Denmark: 2 (4)
China: 5 (2)
Sweden: 0 (2)
Japan: 6 (2)
Iran: 0 (1)
Ireland: 0 (2)
Indonesia: 0 (1)

India 5 (0)
Egypt 3 (0)
Taiwan 1 (0)
Austria 1 (1)
France 2 (0)

Idealab 2 (0?)

Total: 21

* Numbers is parentheses, in this and the next several slides) reflect numbers from 2017 meeting

Responses Recorded

Y/Z AR: 1 (5)
EcochG
CM: 2(1)
SP: 1 (1)
AP: 4 (7)
ABR: 42 (40); (Speech ABR: 6)
MLR: 2 (2)
ASSR/EFR: 17 (19)
FFR: 3 (1)
CAEP: 17 (24); ACC: 9 (?)
ERP:
MMN: 3 (4: included MMR)
P300: 6 (6)
N400: 2 (1)
P600 1 (0)
cVEMPs: 4; oVEMPs 3 (VEMPs: (5))

EEG: 4 (4)
fNIRS: 4 (0)
OAE: 2 (?)
DPOAE: 8 (?)
TEOAE: 6 (?)
SFOAE: 2 (?)
MEG: 1 (?)
Patch Clamp: 1 (?)
Listening Effort: 4 (1)
Systematic Review: 1 (?)
Pupillometry: 1 (?)
Vestibular: 1 (?)
Simulation: 1 (0)
Facial Nerve: 1 (?)
DCN: 1 (?)

‘Subjects’:

Normal-Hearing Young Adults: 56 (55)
Older Adults: 8 (4)
Children: 10
Infants: 8
Hearing Impaired: 8(4)
- Conductive: 1 (7)
- Sensory: ? (4)
- 8th Nerve: 2 (2)
- Auditory Neuropathy: 4 (3)
- Synaptopathy: 2 (8)

Cochlear Implants: 20 (16)
Hearing Aids: 1 (2)
Musical Training/musicians: 1 (3)
Ear Plugging (unilateral): 0 (1)
Diabetes: 1 (1)
Tinnitus: 2 (4)
APD: 1 (1)
Modeling/Simulation: 1 (3)
Susac’s Syndrome: 0 (1)
Down Syndrome: 0 (1)
Narcotics Users: 0 (1)
Zika Virus: 0 (1)
Nasopharyngeal Carcinoma: 0 (1)
Ear Canal Pressure: 0 (1)
Dead Regions: 0 (1)
Meniere’s: 2 (1)
Low-Tone Hearing Loss: 0 (1)
Mild Cognitive Impairment: 1
Listening Effort: 4 (1)
Tuberculosis: 1 (?)
HIV: 1 (?)
Schizophrenia: 1 (?)
Depression: 1 (?)
Motion Sickness: 1 (?)
Unilateral Deafness: 2 (?)
Brain Tumors: 1 (?)
CMV: 1 (?)
Vestibular Schwannoma: 2 (?)
Sudden Hearing Loss: 1 (?)

Non-Human Subjects:

Mice: 2 (1)
Rats: 1 (1)
Guinea Pigs: 1 (1)
Chinchillas: 1 (1)
Dolphins: 2 (4)
Sea Lion: 1 (0)
Gorilla: 1 (0)
Preying mantis: 1 (0)
Cognition: 2 (?)
Dyslexia: 1 (?)
SLI: 1 (?)
ME Implant: 1 (?)
PORP: 1 (?)
Inner ear Anomalies: 1 (?)
Blind subjects: 1 (?)
Simulation: 1 (?)

Stimuli/maskers:

Clicks: 17 (25)
Tonebursts: 13 (16)
Two-Tone: 8 (1)
SAM Tones: 6 (6)
Speech : 20 (39)
Speech-in-noise: 14 (?)
Chirps: 16 (9)
Electrical: 15 (3)
Bone Conduction: 3 (4)
Visual Stimuli: 5 (1)
Emotional Tone, prosody, Intonation: 2 (2)

Gaps: 1 (1)
BBN: 2 (1)
Spectral Rippled Noise: 3 (1)
Forward Masking: (2)
Rippled Noise: 3 (2)
ITD: 1 (?)
Reverberation: 1 (?)
Modulated band-pass noise: 2 (?)
High-pass noise: 1 (?)
Speech-shaped noise: 1 (?)
Music: 2 (?)
Swept tone in noise: 1 (?)
Virtual reality: 1 (?)
Virtual environment: 1 (?)
Hearing Aid: 3 (?)
AM Noise: 2 (?)

Our Australian Hosts:

The Old:
Hal Davis lecture
Podium sessions
Posters
Social events:
Opening ceremony
Excursion
Gala dinner

The New:
Student 5 minute talks
discussion panels

fNIRs/MEG

Cocktail party effect/auditory scene analysis/spatial release of masking:
ITD: EEG/fNIRS- AM noise- 16 sources/detectors- BOLD

Infants/children- Newborn hearing screening/diagnosis- *optimal emitter-detector distance varies with age variable* in infants, habituation to assess speech discrimination- EarGenie- fNIRS/EPs, Heart rate- need to optimize

ITD: MEG: **preying mantis– 1 ear** ILD/ITD; MEG-ASSR to ITD (coherence between envelope and microstructure ITD)- dipole source analysis- posterior auditory cortex- damping function- maxs/mins- max -0.5/+0.5 ms ITD

Imaging

No OAE changes following fMRI

Other:

NRT/CI**: CI vs Cz for ACP-** two look similar; CM: pre-post insertion
NRT/CI: Effect of electrode design on threshold across electrode array
Listening effort/**pupillometry**, **alpha power**-speech in noise- free field
Ion channels and rat cochlea- patch clamp BK1/BK2
TEOAEs/suppression/selective attention- visual/auditory OAEs/P3- no change in suppression. Needs lots of averaging to get a good SNR estimate of suppression
MMN/MMR: Test/retest reliability in children w/ **APD Discriminant Analysis**
MMR/infants- Speech Discrimination/machine learning (trained a support vector machine)
MMR variables predicted later assessed speech discrimination

CAEPs I

ACC speech/non-speech in children- short-duration stimuli- gaps in tones, vowel pairs- tones showed more ACC than vowel pairs

Temporal response function (TRF)- entrainment of EEG (4-12 Hz) to running speech **- use EEG to predict speech envelope- 70 dBA**- HI listeners no difference in aided/unaided. Does compression affect results?

ALR automatic detection- **bootstrap method-** can use Hotelling T2, Modified q-samples, Fmp, correlation coefficient, covariance, **dynamic time warping**. DTW COV the best in simulation. Hotelling T2 as good as audiologists. Template matching- variable results in infants.

ACC in infants: speech contrasts and rippled noise- parent report and language development, behavioral measures of contrast detection some in future)- CAEP, ACC1, (ACC2,) offset2 (longitudinal, both NH and HI)

Informational and energetic masking in speech-evoked CAEPs and ACC- tonal and speech (VCV) stimuli,- gap like, different maskers- speech shaped noise, babble, 2- and 8 talker babble- need to separate crest factor and amplitude modulation effects of maskers

Silent lip reading- CIs/NH/HI pre-op VEPs- cross modal plasticity- LORETA/time-frequency analysis- behavior, confidence, VEP, alpha oscillations.

CAEPs II

CAEPs and loudness: sensory gating, serotonin levels- changed in schizophrenia- affects CAEPs (OCD, depression, bipolar disorders) **LDAEP- need to read outside our field**

ACC-CI- Discrimination paradigms- vowel pairs, gap in tones, speech perception in noise- poorer performance in CI patients than NH group

CI/hearing preservation- **is hearing preservation important for CI patients**? N1-P2 CAEP/ACC- and behavioral measures. No difference in sentence recognition. Pulse duration discrimination-no difference between groups; ACC N1 amplitude larger for ACC in HP group, but not latencies. **What does it mean if no behavioral difference but some AEP differences?**

N1/P2 CAEP in noise, unilateral CI- **sound localization**: N1/P2, 64 channel- BESA- RT (no difference across groups). P2 amplitude decreases with noise- difference with NH in quiet- not in noise. CAEP changes seen with spatial location- different source localization in CI than NH group.

Intraoperative monitoring: eCAP useful for CI mapping, eABRs also monitored. Looked at those with poor eCAP and/or poor eABR (fewer than 18 viable channels). **Cockayne syndrome, LVAS, CMV, RTD, CHARGE, Connexin 26**

CAEPs III

CI critical period 2nd implant- variable time between- duration of response decreases over time, but P1 latency similar for 2nd CI as 1st
Age: Performance in quiet, normal hearing adults- speech tests, ABR click, CAP: tones and speech, cognitive assessment; Some CAEP changes; no difference in P3
AEPs/speechinnoise/aging/hearingloss- Age related MLR/CAEP changes- amplitude and latency changes with both aging and HI; Speech in noise and AEPs: Pa amp related by poorer speech in quiet and noise, and N2 latencies
SVP dolphins to clicks- habituation- aliasing effect of ABR an issue
EEG alpha and listening effort in CI- 4 talker babble in a speaker array, **beamforming, consistency analysis- Left inferior frontal gyrus (and inferior occipital gyrus) alpha related to listening effort**

N400-Speech: adults 19-62, MOCA (cognitive), normal audiograms- no behavioral differences across groups in those with listening differences. N400- congruent versus incongruent sentences- SVP and N400 – difference in scalp distribution across groups

ASSR

eASSR- **electrical artifact reduction**
Chirps and tones- NB chirp larger than SAM tones
NB chirp rate and **automatic response detection- SNR, and multiple harmonics-**
When summing all harmonics, need to consider minimum SNR for a harmonic, and how to sum the harmonics
LLASSR- in folks with NH and hearing loss- can derive a LLR from LLASSR
Simulated conductive loss, and those with SNHL- strong relationship between LLASSR, LLR and behavioral thresholds
LLASSR- complex spectrum- compare behavioral thresholds with objective detection of LLRs
ASSR in CI patients (children) with residual hearing- different results in ABR and ASSR has been reported in literature- single CI, bilateral CI (either simultaneously implanted or sequentially implanted)- lower electrical thresholds for those with more residual hearing
ASSR: **NB chirps- multiple stimulation-** parameters affect this- ~40 Hz.- drop in amplitude with multiple stimuli
ASSR/**sudden HL**/**Behavioral Audiometry**: differences in AEPs and audiogram is some subjects
NB Chirps in infants: normative threshold study in term infants- 4 simultaneously
ASSR & Neuropathy: discuss an odd case study- Down Syndrome-SP?
Simulated room acoustics and ASSR/chirp: **Reverberation time** and modulation power

ABR I

Up and down narrow band chirps- short frequency-specific chirps- upward chirps larger (NOT 500 Hz)

Dolphin ABR offset responses

D-met dose/response- ABR in chinchilla to impulse or steadystate noise- broad effective dosing range. Better results from steadystate than impulse noise.

ABR/DPOAE in normal hearing type II **diabetic**s and nondiabetics- ABR changes noted- including the I-V interval. DPOAEs smaller.

Specific Language Impairment (SLI) – several subtypes- psychophysical and cABR
CAPD related to SLI? /da/- SLI affects select cABR dependent variables.

cABR- In those with hearing aids- /ba/- compared behavioral testing in older subjects to cABR- place and nasality- ba-da, ba-ma; decrease in FFR amplitude over time of hearing aid use

School-aged children ABR/OAEs (contralateral suppression)- kids with ABR and controls (no correlations with behavioral measures (no difference in cABR in previous work). Maybe an effect on ABR overall amplitude- III-V area. No TEOAE differences across groups; no differences in suppression. Saw contra MEMR differences across groups

ABR II

Synaptopathy- wave I slope not different in those with recreational noise exposure NEQ

Acoustic Neuroma and ABR click/chirp: ROC analysis- area under the curve- Duration?

Effective masking levels for BC ABR: adults vs babies- AC masking-binaural- occlusion effect an issue

IEM: Inner ear malformation- a simple classification- eABR, CAP (categories of auditory performance)- eCAP and CAP scores varied w/ IEM type

ABR/CAEP to natural speech stimuli: Latency dependent filter I-RSA

eABR/CI- **preoperatively as a prognostic index**

OAEs

DPOAEs and Phase suppressor tone- **SFOAEs, break from scaling symmetry in DPOAEs to 16 kHz (as well as apex)**

DPOAEs/ABR/Audiometry (extended frequency)/Admittance in **childhood brain tumor survivors-** > half had a hearing loss and DPOAEs and ABR changes in some patients

Probe fitting: **forward pressure** TEOAEs affected by several insertion parameters

Efferent sensitivity and **temporal fluctuations SFOAEs AM noise tMTF** (SOAEs for spectral modulation)

Mesenchymal stem cell transplantation post ouabain-induced apoptosis C57/BL6 some injected with human bone marrow ABR/DPOAEs- some ABR threshold improvement

VEMPs

Motion sickness- visual and vestibular function- VEMPs and motion sickness- motion sickness questionnaire- calorics and 3-D virtual reality- roller coaster, cVEMP/oVEMP- no relationship of VEMPs with symptoms of motion sickness

Likes and dislikes (strictly Bob's opinion)

Acoustics: dBA, describe your stimulus

Reliability etc:

Imaging/fNIRs: Blood flow

Synaptopathy/Hidden hearing loss (McAlpine):

The Audiogram: Aging

Perceptual Measures

Grand averages:

APD/Dyslexia/SLI etc:

Is newer always better?:

Ecologically-valid Stimuli:

Listening Effort/pupilometry:

Cognition:

Thank You ('Ta'):

Robert Cowan
Chair, IERASG Organizing Committee
Mridula Sharma
Member, IERASG Organizing Committee
Fabrice Bardy
Member, IERASG Organizing Committee
Suzanne Purdy
Chair, IERASG
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