

Photic Stimulation

Literature Review

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Luton & Dunstable University
Hospital

Technical and Methodological Considerations in Photic Stimulation for EEG

© RM Sherratt

First light source

Car Headlamp - beam interrupted by rotation

Adrian ED & Matthews BHC (1934)

The Berger rhythm: potential changes from the occipital lobes in man.

Brain 57: 355-385



Lord Adrian



Sir Bryan Matthews

Xenon Flash



Dr Harold Edgerton - MIT

LED pioneers



Henry Joseph Round



Oleg Vladimirovich Losev



W Grey Walter



Analysis of the electrical response of the human cortex to photic stimulation

W Grey Walter, VJ Dovey & H Shipton (1946)

No. 4016 October 19, 1946

NATURE

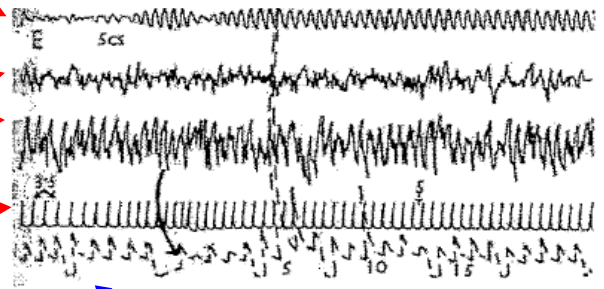
541

Derived
response

EEG

Flashes

Spectrum



ANALYSED ELECTRO-ENCEPHALOGRAMS TAKEN DURING EXPOSURE TO FLICKERING LIGHT. IN EACH RECORD THE TOP TRACE SHOWS THE RESPONSE AT A SELECTED FREQUENCY AS INDICATED. THE SECOND AND THIRD TRACES ARE THE ELECTRO-ENCEPHALOGRAMS FROM THE REGIONS INDICATED BY THE HEAD DIAGRAM. THE FOURTH TRACE SHOWS THE FLASHES OF LIGHT AS SEEN BY A PHOTO-ELECTRIC CELL BETWEEN THE SUBJECT'S EYES. THE FIFTH TRACE (DOTTED) IS THE FREQUENCY SPECTRUM OF THE RECORD INDICATED BY THE ARROW. THE AMPLIFICATION AND TIME-SCALE FOR A, B, C, D, E ARE GIVEN IN A. THE ANALYSER SCALE IS ADJUSTED TO A CONVENIENT SIZE FOR EACH RECORD

Central effects of Rhythmic Sensory Stimulation (1949)

VJ Walter & W Grey Walter EEG journal. 1:57-86

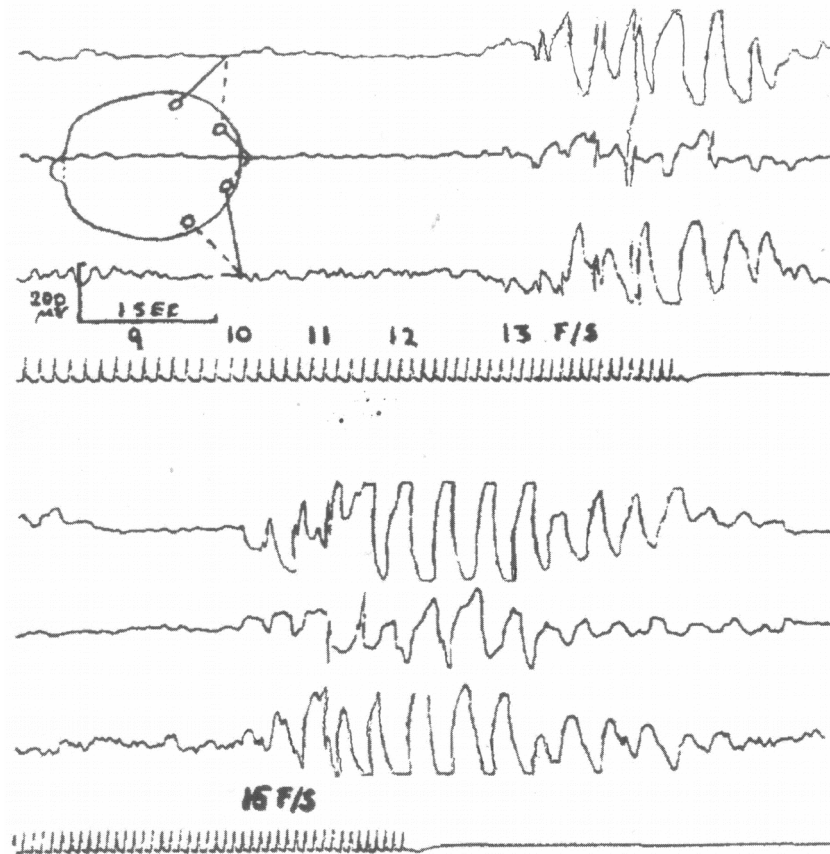


Fig. 11

Two occipital larval seizures induced in an epileptic child by stimulation at the frequencies indicated. No clinical accompaniments.

UK Incidence

Incidence of photosensitive epilepsy: a prospective national study

J.A. Quirk *, D.R. Fish, S.J.M. Smith, J.W.A.S. Sander, S.D. Shorvon, P.J. Allen

Department of Clinical Neurophysiology, The National Hospital for Neurology and Neurosurgery, Queen Square, London WC1N 3BG, UK

Accepted for publication: 23 May 1995

Abstract

We undertook a prospective nationwide study to determine the incidence of photosensitive epilepsy (PE). Virtually all EEG departments in Great Britain (providing approximately 90% coverage of all EEGs performed on people with newly diagnosed seizures) screened cases referred to them over a 3 month period and identified all new cases of epilepsy (defined as one or more recognised seizures) whose first EEG showed a photoparoxysmal response (PPR) on intermittent photic stimulation (IPS). 191 cases were identified, 143 of whom had type 4 PPRs (generalised spike and wave on IPS) on their first EEG. The annual incidence of cases of epilepsy with type 4 PPRs on their first EEG was conservatively estimated to be 1.1 per 100,000, representing approximately 2% of all new cases of epilepsy. When restricted to the age range 7–19 years, the annual incidence rose to 5.7 per 100,000 – approximately 10% of all new cases of epilepsy presenting in this age range. To ascertain if there was a significant seasonal variation in PE, 5 EEG departments (which together contributed 15% of cases in the first study period) were visited during a second 3 month study period to identify all new cases of epilepsy with type 4 PPRs on their first EEG. No significant seasonal variation in incidence between summer and winter was found.

Stimulus attributes (xenon)

Brightness of flashes

Structure

Diffusion

Lamp geometry

Lamp distance

Colour

Stimulus attributes (xenon)

“The criterion for an abnormal tracing was taken as a photoconvulsive response.....

..it was quite clear that a stimulus of maximal intensity gave a consistently maximal electroencephalographic response...

...whereas with lesser values of illuminance this abnormal electroencephalographic recording varied in an **approximately proportional manner**.

Brausch CC & Ferguson JH (1965)
Neurology 15: 154-164

Stimulus attributes (xenon)

Brightness

Structure

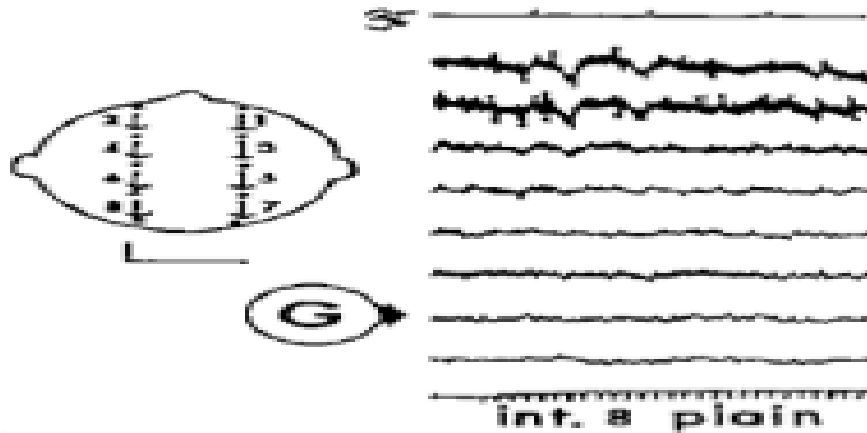
Diffusion

Lamp geometry

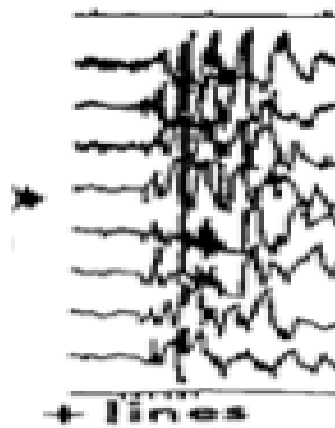
Lamp distance

Colour

Grass PS: plain vs structured stimulus



Opaque glass



+ Vertical
lines

Stimulus attributes (xenon)

Structure

Brightness

Diffusion

Lamp geometry

Lamp distance

Colour

Stimulus attributes (xenon)

Structure

Brightness

Diffusion

Lamp geometry

Lamp distance

Colour

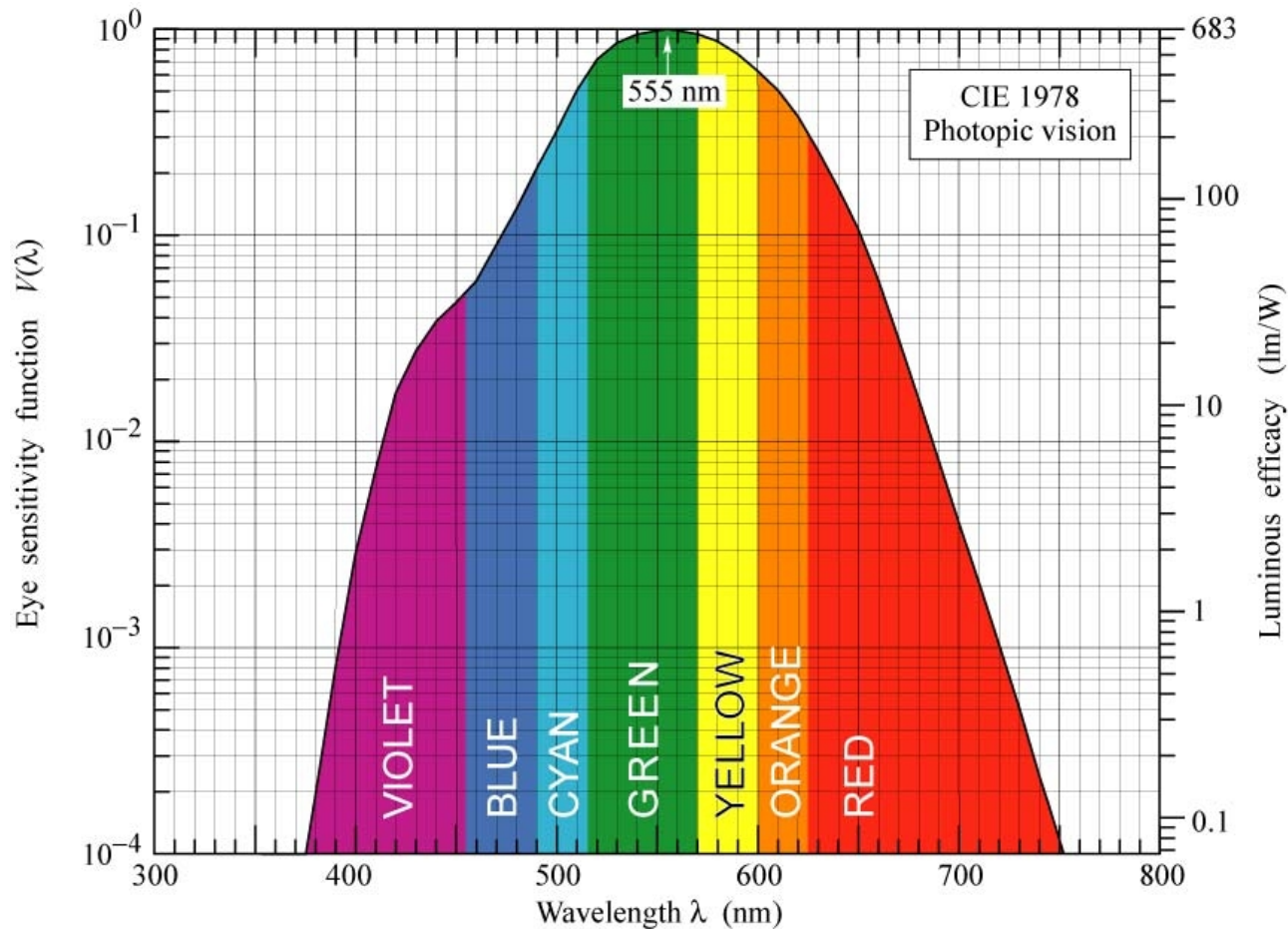


Fig. 16.7. Eye sensitivity function, $V(\lambda)$, (left ordinate) and luminous efficacy, measured in lumens per Watt of optical power (right ordinate). $V(\lambda)$ is greatest at 555 nm. Also given is a polynomial approximation for $V(\lambda)$ (after 1978 CIE data).

Procedural factors

Timing within the EEG

Binocular vs Monocular

Eccentric gaze

Lamp distance

Ambient lighting

Flash rates

Flash train duration

Eyes open/closed/closure

When to quit

Binocular vs Monocular

Sensitivity limits

Patient

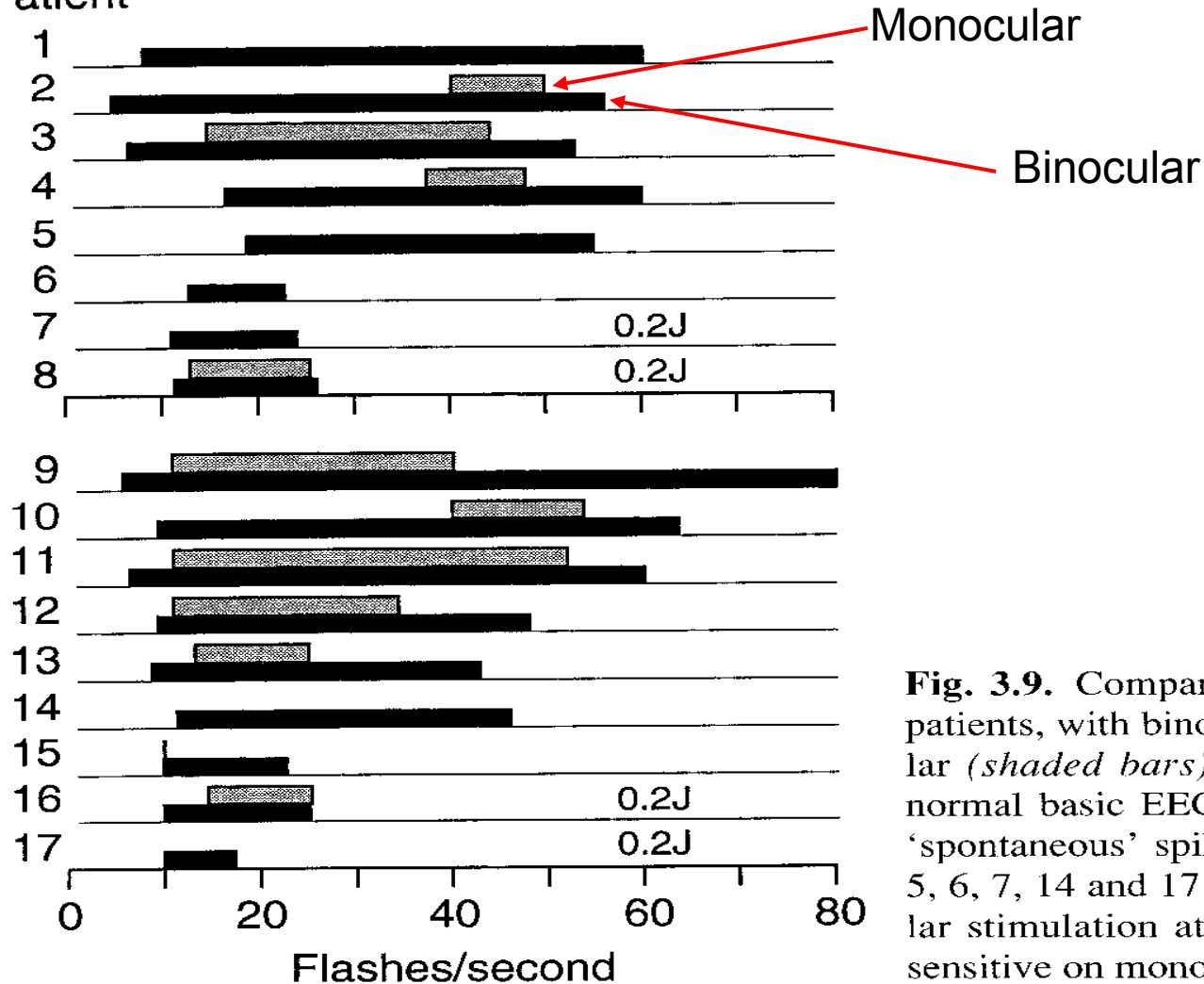


Fig. 3.9. Comparison of sensitivity limits in 17 patients, with binocular (*black bars*) and monocular (*shaded bars*) stimulation. Patients 1–8 had normal basic EEGs, while patients 9–17 showed ‘spontaneous’ spike-wave discharges. Patients 1, 5, 6, 7, 14 and 17 did not show PPRs on monocular stimulation at any flash rate. Patient 15 was sensitive on monocular stimulation only at 10 f/s.

Binocular vs Monocular

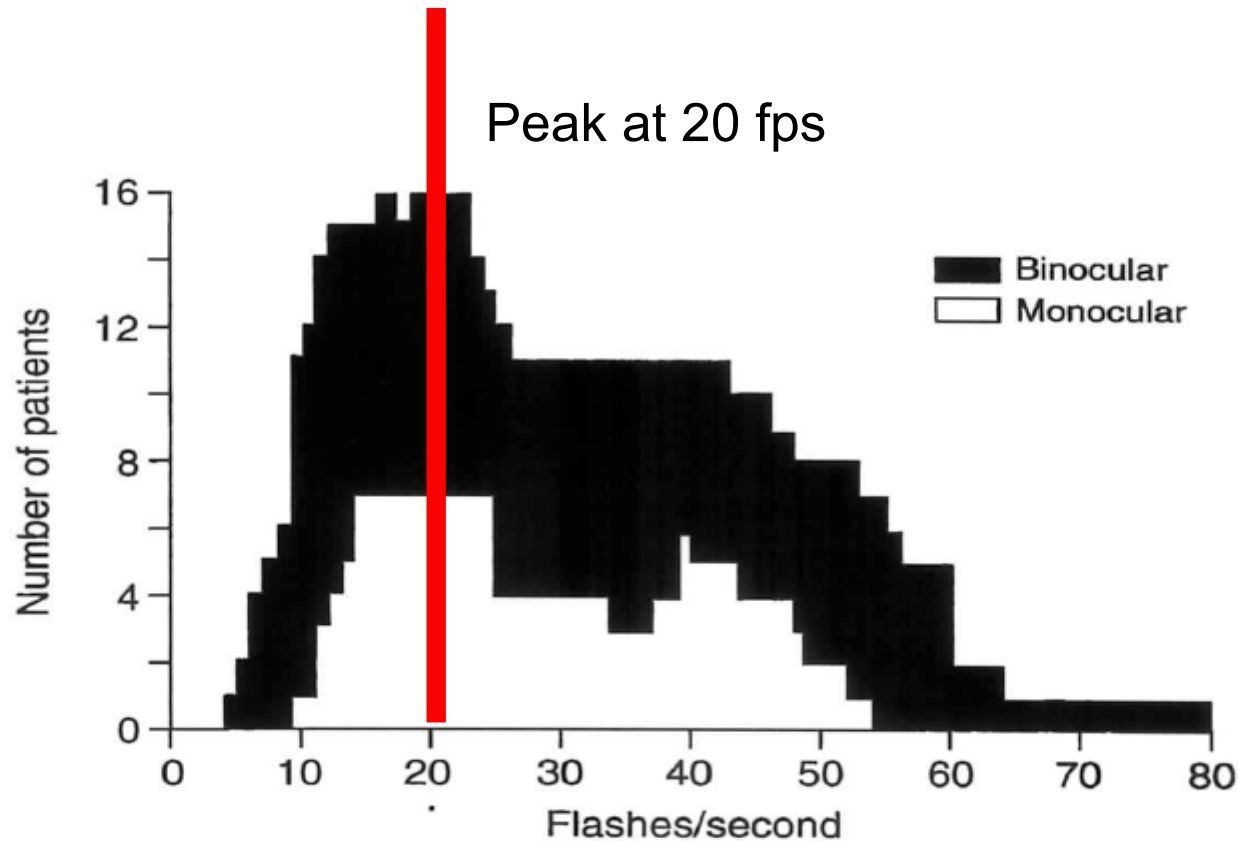


Fig. 3.10. Comparison of monocular and binocular stimulation in 16 patients. Peak sensitivity was at 20 f/s in both states, and the patterns of sensitivity were very similar, but the monocular responses were markedly less.

Eccentric gaze

Jeavons & Harding 1975

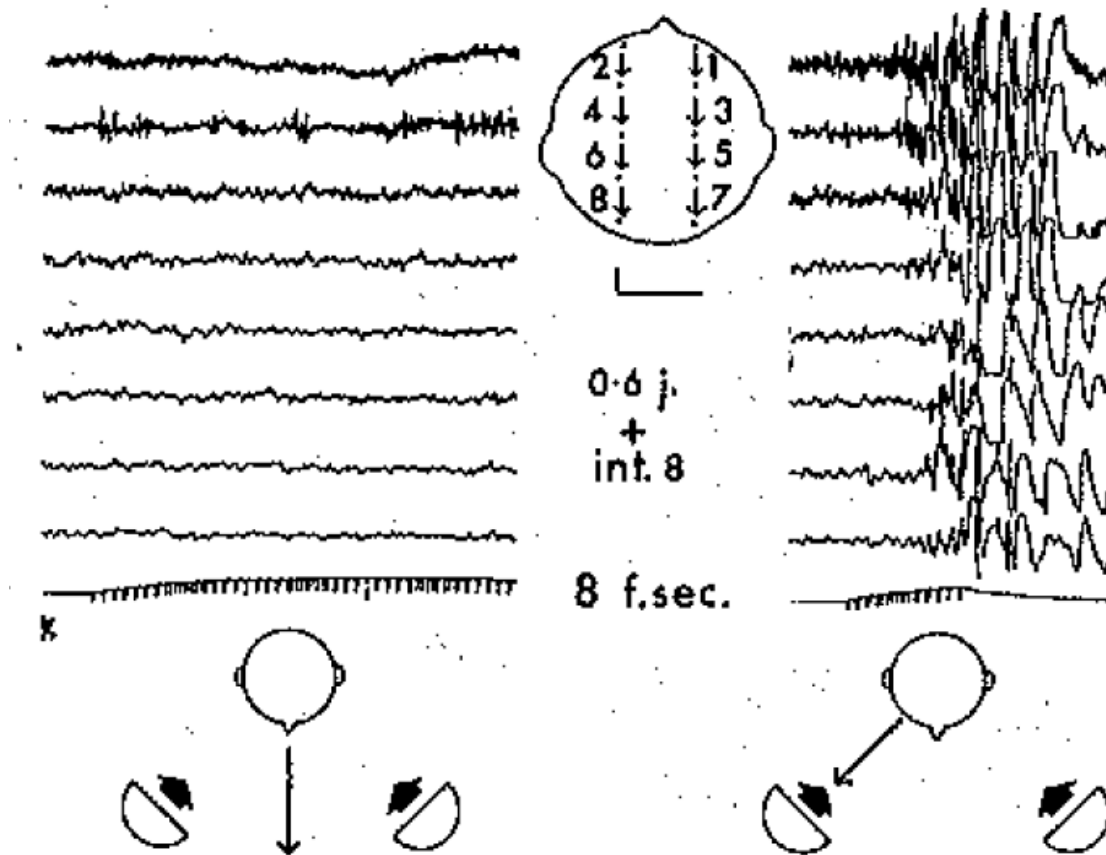


Fig. 39. Same patient as Figures 37 and 38. A PCR is evoked when the patient looks at one of the lamps (right hand trace).

Human and other factors

Age

Natural history

Genetics – family history

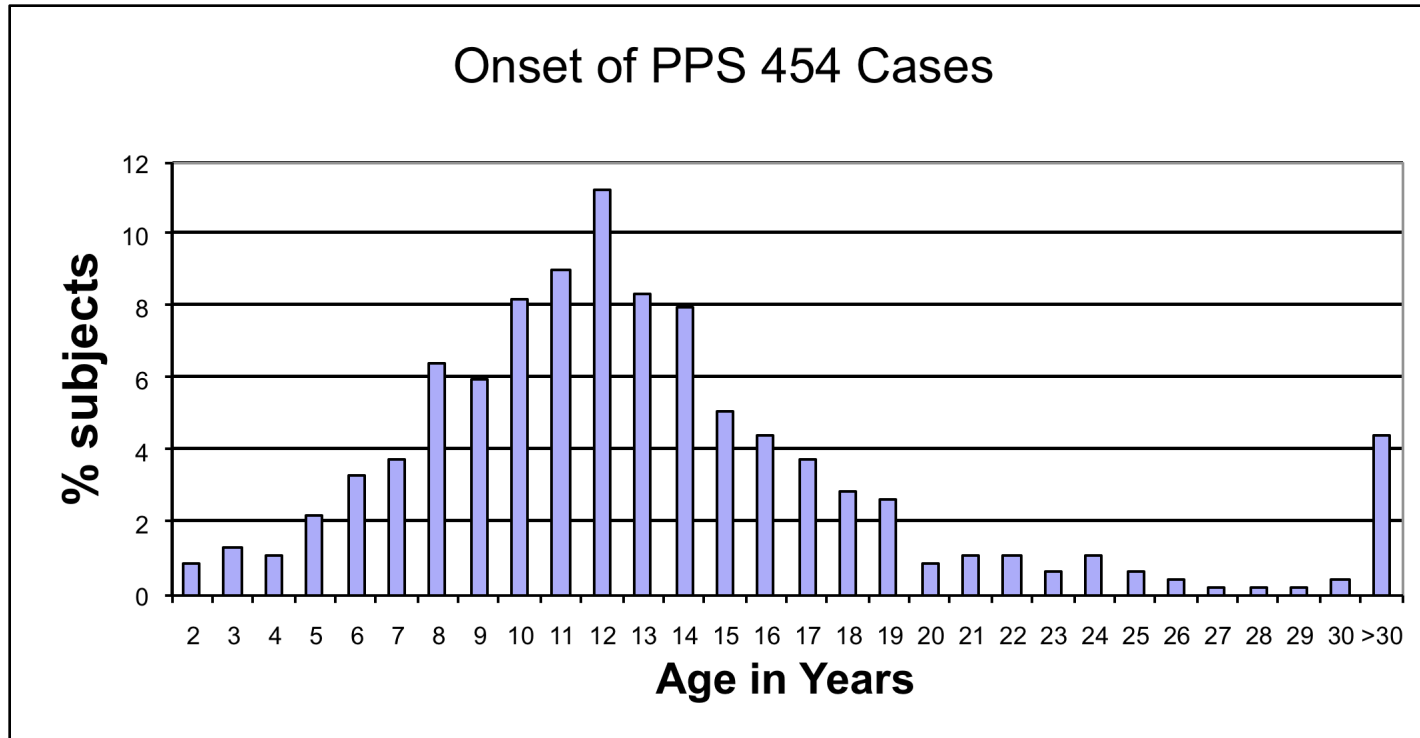
Underlying condition

Sleep deprivation ↑

Anticonvulsant exposure ↓

Age of onset

Harding & Jeavons (1994)



Persistence PPR +/-Seizures

Epilepsia, 38(6):663-669, 1997
Lippincott-Raven Publishers, Philadelphia
© International League Against Epilepsy

Persistence of Photosensitivity

G. F. A. Harding, A. Edson, and P. M. Jeavons

Department of Vision Sciences, Clinical Neurophysiology Unit, Aston University, Birmingham, England

Summary: *Purpose:* One hundred patients with photosensitive epilepsy were investigated as part of an ongoing follow-up study. Average duration of follow-up was 14 years; mean age at follow-up was 27 years.

Methods: All patients were EEG investigated using a standard technique of intermittent photic stimulation (IPS). The presence of a photoparoxysmal response (PPR) or a degraded PPR indicated the presence of photosensitivity.

Results: Seventy-seven patients became seizure free. Of the untreated patients, photosensitivity disappeared in 14 patients but was present in 32 patients. Of the patients who were treated, 31 showed evidence of PPRs or degraded

PPRs, but 23 patients no longer showed evidence of photosensitivity. Thirty-two mothers had 67 children during the follow-up period. Thirteen have so far proved to be sensitive to IPS in the laboratory and four have also had photosensitive seizures induced in the outside environment. Nine of the children have been found not to be photosensitive nor have they had seizures.

Conclusions: This study suggests that photosensitivity persists in at least two thirds of patients with photosensitive epilepsy and that valproate is effective in controlling this photosensitivity. **Key Words:** Photosensitive epilepsy—Photoparoxysmal response—Intermittent photic stimulation—Sodium valproate.

Human and other factors

Age

Natural history

Genetics – family history

Underlying condition

Sleep deprivation

Anticonvulsant exposure

Genetic links to PPR



Epilepsy Research

Volume 89, Issues 2–3, May 2010, Pages 286–294



Whole-genome linkage scan for epilepsy-related photosensitivity: A mega-analysis

C.G.F. de Kovel^a,  , D. Pinto^{b, c}, U. Tauer^m, S. Lorenz^{k, r}, H. Muhle^j, C. Leu^d, B.A. Neubauer^f, A. Hempelmann^k, P.M.C. Callenbach^l, I.E. Scheffers^{g, h}, S.F. Berkovic^{g, h}, G. Rudolfⁱ, P. Striano^q, A. Sirenⁿ, B. Baykan^{o, p}, T. Sander^{d, e, k}, D. Lindhout^a, D.G. Kasteleijn-Nolst Trenité^a, U. Stephanij, B.P.C. Koeleman^a

“different genetic risk factors underlie the PPR in the different family subsets”

Interim summary

Precise details of stimulation often lacking

No standard protocol

Patient “types” varied: age / condition /
medications

Extent of documentation varied

Fragmented patchy datasets

Changes in lamps: Xenon **now LED**

No calibration

Best single sources: Harding & Jeavons (1975 & 1994).

Most prolific author: Kasteleijn-Nolst Trenité

Experts

- Jeavons, P. M., Harding, G. F. A., 1975. *Photosensitive epilepsy. A review of the literature and a study of 460 patients*. London:William Heinemann Books.ISBN 0433172010 / 0-433-17201-0
- Kasteleijn-Nolst Trenité, D. G. A., Binnie, C. D., Harding, G. F. A., Wilkins, A., Covanis, T., Eeg-lofsson, O., Goosens, L., Henriksen, O., Krtimer, G., Leyten, F., Lopes Da Silva, F. H., Martins Da Silva, A., Naquet, R., Pedersen, B., Ricci, S., Rubboli, G., Spekrijse, H., Waltz, S., 1999b. Medical technology assessment. Photoc stimulation - Standardization of screening methods. *Neurophysiologie Clinique*. 29 (4). 318-324
- Kasteleijn-Nolst Trenité, D. G. A., Guerrini, R., Binnie, C. D., Genton, P., 2001. Visual Sensitivity and Epilepsy: A Proposed Terminology and Classification for Clinical and EEG Phenomenology. *Epilepsia*. 42 (5). 692-701.
- Kasteleijn-Nolst Trenité, D. G. A., Rubboli, G., Hirsch, E., da Silva, A. M., Seri, S., Wilkins, A., Parra, J., Covanis, A., Elia, M., Capovilla, G., Stephani, U., Harding, G., 2012. Methodology of photic stimulation revisited: Updated European algorithm for visual stimulation in the EEG laboratory. *Epilepsia*. 53(1). 16-24.

CRITICAL REVIEW AND INVITED COMMENTARY

Methodology of photic stimulation revisited: Updated European algorithm for visual stimulation in the EEG laboratory

***Dorothee Kasteleijn-Nolst Trenité, †Guido Rubboli, ‡Edouard Hirsch, §Antonio Martins da Silva, ¶Stefano Seri, #Arnold Wilkins, **Jaime Parra, ††Athanasios Covanis, ‡‡Maurizio Elia, §§Giuseppe Capovilla, ¶¶Ulrich Stephani, and ##Graham Harding**

***Department of Neuroscience, University Sapienza, Rome, Italy; †Neurology Unit, IRCCS Institute of Neurological Sciences, Bologna, Italy; ‡Department of Neurology, Hopitaux Universitaires de Strasbourg, Strasbourg, France; §Department of Neurological Disorders and Senses, Hospital Santo António, Oporto, Portugal; ¶School of Life and Health Sciences, Aston University, Birmingham, United Kingdom; #Visual Perception Unit, University of Essex, Colchester, United Kingdom; **Epilepsy Unit, Hospital La Zarzuela, Madrid, Spain; ††Neurology Department, Agia Sophia Children's Hospital, Athens, Greece; ‡‡IRCCS Associazione Oasi Maria SS, Troina, Italy; §§Epilepsy Center "C. Poma Hospital," Child Neuropsychiatry Department, Mantova, Italy; ¶¶Neuropediatric Department, University of Kiel, Kiel, Germany; and ##Vision Sciences, Aston University, Birmingham, United Kingdom**

2012 Consensus group -1

Get a proper history

No special requirements prior to attending

Get informed consent*

Perform at least 3 minutes after
hyperventilation

Perform for the first time always while the
patient is awake after a normal night's sleep

Use dim room lighting

Patient upright (plus video if appropriate)

Ensure a recording with at least 2.5 minutes
with each of eyes open and eyes closed
before IPS.

2012 Consensus group -2

Lamp with circular reflector with intensity of at least 0.7 Joule* and no grid.

30 cm distance

Explanation to include what will happen and what precautions will be taken to prevent a seizure

Instruct on looking at centre of lamp and obeying eyes open eyes closing

Always stop the stimulus as soon as generalised discharges occur irrespective of if self-limiting

Determine IPS sensitivity in 3 conditions with separate trains of flashes of 5 seconds duration each during eye-closure, eyes closed, and eyes open

2012 Consensus group -3

If time is short, examine the eye closure condition at the start of a 7 second flash train for each flash frequency.

Use the following flash frequencies in this order: **1 – 2 – 6– 8 – 9 – 10 – 13 – 15 – 18 – 20 – 23 – 25 –30 – 40 – 50 –60 Hz.**

If there is a generalized response at a certain frequency, skip the remainder of the series and continue then with 60 Hz and go down in frequencies (60 – 50 – 40 – 30 –25 Hz-...) until again a PPR occurs.

Retest after a 10 second rest if there is doubt.

Observe for clinical changes

Assessment of Results

Localised occipitally

Occipital becoming generalised

Generalised

Periocular myoclonic ('Orbital
myoclonus')

- Classifications

Response classifications suggested by the 1999 group

GSW generalised (ir) spike-and-waves or polyspikes-and-waves

OGSW Temporo-occipital beginning, generalising (ir) regular, spike-and-waves, or polyspike-and-waves

OSW Temporo-occipital (ir) regular, spike-and-waves, or polyspike-and-waves

OR other responses

An alternative EEG classification system proposed by Waltz et al (1992) is as follows

Class I represents occipital spikes;

Class II, local parieto-occipital spikes and biphasic slow waves

Class III parieto-occipital spikes and biphasic slow waves spreading to frontal regions

Class IV, generalized spikes or polyspikes and waves.

A further categorisation of photic patterns was suggested by Jeavons and Harding

- responses seen only in the anterior regions (photomyoclonic)
- responses seen only in the posterior region (photic driving, visual evoked potentials, occipital spikes)
- responses that are widespread, anterior and posterior, bilateral responses (photoconvulsive).

J Med Ethics 2003;**29**:4-7

Symposium on consent and confidentiality

Some limits of informed consent

Onora O'Neill Newnham College Cambridge

Many accounts of informed consent in medical ethics claim that it is valuable because it supports individual autonomy. Unfortunately there are many distinct conceptions of individual autonomy, and their ethical importance varies. A better reason for taking informed consent seriously is that it provides assurance that patients and others are neither deceived nor coerced.



Guidance for doctors

Online guide

Consent: patients and doctors making decisions together

General
Medical
Council

Regulating doctors
Ensuring good medical practice

Consent

49 You should also get written consent from a patient if:

- (b) there may be significant consequences for the patient's employment, or social or personal life

Involving children and young people in making decisions

- 54 You should involve children and young people as much as possible in discussions about their care, even if they are not able to make decisions on their own.
- 55 A young person's ability to make decisions depends more on their ability to understand and weigh up options, than on their age. When assessing a young person's capacity to make decisions, you should bear in mind that:
 - (a) a young person under 16 may have capacity to make decisions, depending on their maturity and ability to understand what is involved
 - (b) at 16 a young person can be presumed to have capacity to make most decisions about their treatment and care.

Consent ~ Risk Mitigation

Requires

an adequate clinical history to be taken with special reference to the patient and immediate family

Requires

properly informed consent from the patient, or the proxy, to the different components of the procedure

This process might involve:

the reason for IPS, the broad risks both clinical and re driving licence to the patient -and anyone accompanying. The conditions for stopping IPS by either clinical physiologist or patient.

Retention of proper documentation

Main Points

History

Consent

Ambient lighting

Positioning of lamp

Flash rates and sequencing

Eyes open - closed - closure

When to stop !

Men in shirts: Bardeen Shockley Brattain

Nobel
Prize for
Physics
1956

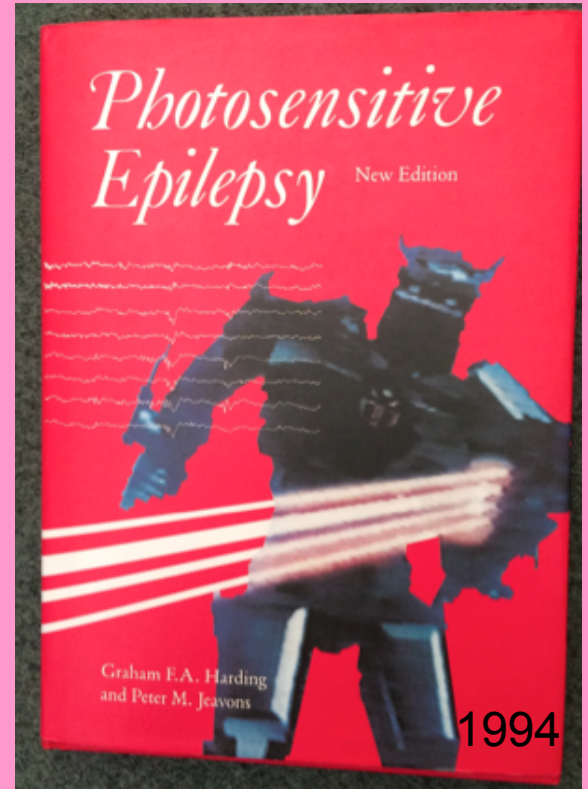


Acknowledgements

Professor Graham Harding

Nicola Pilsbury

Kim Whitehead



Thank you for listening

Full review available via email

msherratt@nhs.net

Arising.....

Consent. Neurophysiology Departments carrying out routine EEG might have standard consent procedures that

- **require properly trained and supported staff to carry out the tests**
- **require an adequate clinical history to be taken with special reference to the patient and immediate family**
- **involve obtaining properly informed consent from the patient, or the proxy, to the different components of the procedure: the process might include the reason for IPS, the broad risks both clinical and re driving licence to the patient and anyone else nearby, and the general reasons for IPS. The conditions for stopping IPS by either clinical physiologist or patient might be stated.**
- **are properly documented.**

Standard Operating Procedures. Departments might have standard operating procedures that mention

- **what will happen**
- **making a rough risk assessment on clinical and EEG data prior to IPS**
- **setting ambient lighting for IPS**
- **setting and measuring the distance of the lamp from the eyes**
- **what the patient should look at ? fixation spot**
- **the stimulation suites or the general rules governing selection and sequencing of flash trains**
- **simultaneous video monitoring**
- **what to do in the event of discerning abnormal EEG changes**
- **what support could be available to deal with IPS induced (or other) seizures**

Analysis. Potential points of interest

- ❑ **what the criteria are for considering the EEG to be abnormal**
- ❑ **source of the criteria**
- ❑ **what level of description is expected in the factual / clinical conclusion**
- ❑ **does the department use a formal classification based on published criteria**

1. Explanation to patient and carer-consent
2. Assessment of clinical and EEG data prior to IPS
3. Policy for ambient lighting
4. Setting and measuring the distance of the lamp from them eyes
5. What the patient should look at - fixation spot
6. Rules governing selection and sequencing of flash trains
7. Simultaneous video monitoring / eyeballing
8. What to do in the event of discerning abnormal EEG
9. Support to be available to deal with IPS induced seizures

Faggin, Hoff & Mazor



Intel 4004 Microprocessor produced in 1971

The Safety & Efficacy of Photic Stimulation During EEG

**A National Survey
Evaluation: Review of the
Safety Survey**

Methodology

- 83 forms were sent out
- 61 were completed and returned

Response Rate = 74%

FORM A : Please complete once only for each department

Postcode of Centre (Please complete)					
1. Do you use published guidelines for safety of Photic Stimulation?	Yes / No				
2. If so please give reference(s)					
3. Do you use a local protocol for safety of Photic Stimulation?	Yes / No				
4. If so please attach copy	Attached / not applicable				
5. Do you obtain consent for Photic Stimulation?	Yes / No				
6. If you do obtain consent, please provide details of your method used and attach any relevant documentation					
7. Have you performed a local or regional audit on the safety and / or efficacy of photic stimulation?	Yes / No				
8. If so please provide a summary and main recommendations.					
9. Do you recall any generalised tonic clonic seizures (GTCS) or adverse events during photic stimulation in your department?	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%; padding: 2px;">GTCS</td> <td style="width: 40%; padding: 2px;">Yes / No</td> </tr> <tr> <td style="padding: 2px;">Adverse event(s)</td> <td style="padding: 2px;">Yes / No</td> </tr> </table>	GTCS	Yes / No	Adverse event(s)	Yes / No
GTCS	Yes / No				
Adverse event(s)	Yes / No				
10. If so, please give details and has there been a change in clinical practice as a result?					
11. Do you have a protocol for dealing with seizures?	Yes / No				

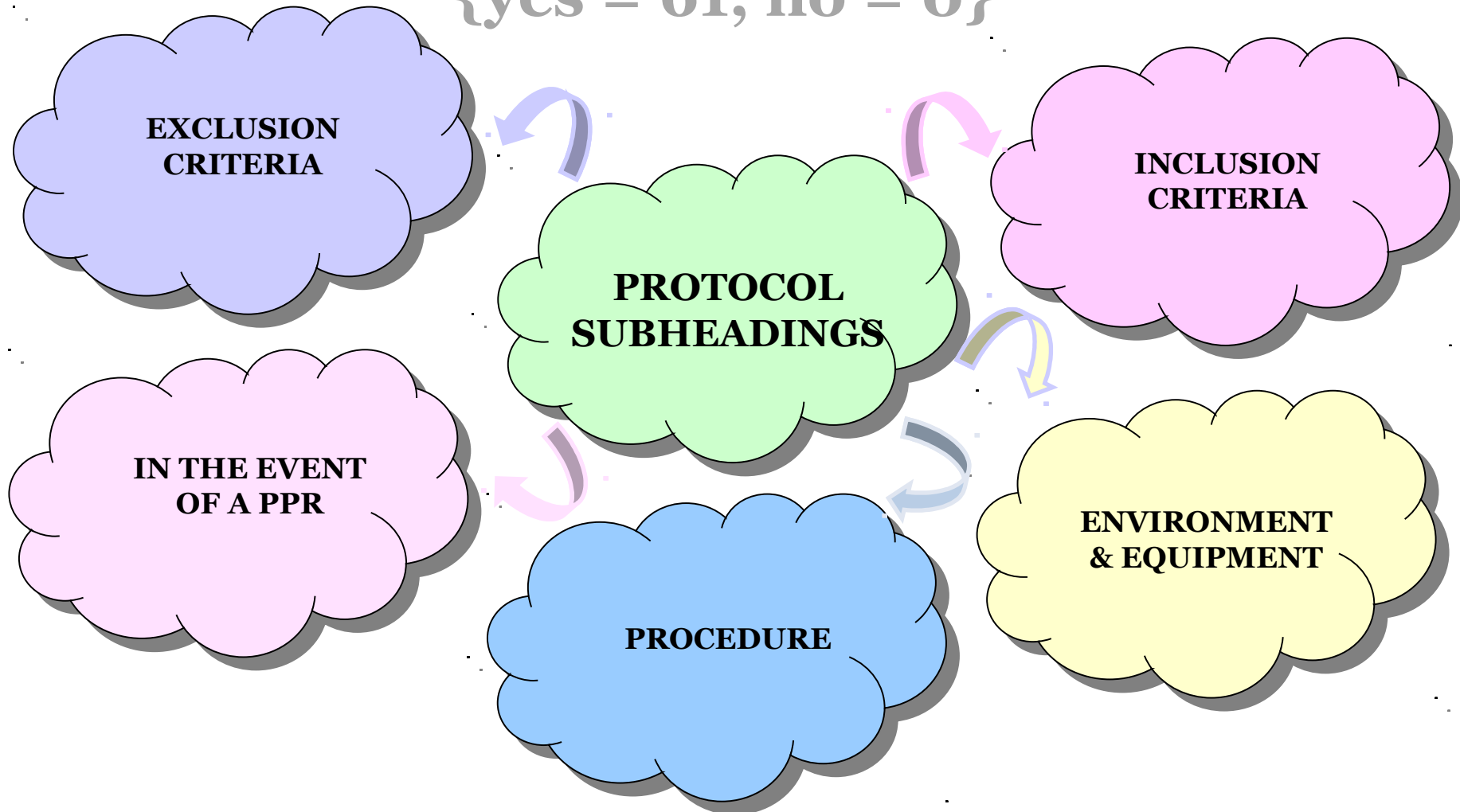
Do you use published guidelines for the safety of photic stimulation?

{yes = 34, no = 26}

- Photic stimulation: standardisation of screening methods (Kasteleijn-Nolst Trenite, D.G.A, Binnie, C.D., Harding, G.F.A & Wilkins, A. 1999 Epilepsia, volume 40)
- Methodology of photic stimulation revisited: Updated European algorithm for visual stimulation in the EEG laboratory (Kasteleijn-Nolst trenite, D., Rubboli, G., Martinsda Silva, A., Seri, S., Wilkins, A., Parra, J., Covanis, A., Elia, M., Capovilla, G., Stephani, U. and Harding, G. Epilepsia 53(1) 16-24, 2012)
- Clinical Neurophysiology, volume 2. EEG, Paediatric Neurophysiology, Special Techniques and Applications (Binnie, C., Cooper, R., Mauguiere, F., Osselton, J., Prior, P and Tedman, B.)
- Effectiveness of photic stimulation on various eye-states in photosensitive epilepsy (Panayiotopoulos, C.P.) October 1974 volume 23 issue 2 pages 165-173
- Niedermeyer's EEG: Basic Principles, Clinical Applications and Related Fields: Sixth Edition (Schomer, D.L., Lopes Da Silva, F.H. 2011)
- Photosensitive Epilepsy (Harding and Jeavons) 1994 Chapter 3

Do you use a local protocol for the safety of photic stimulation

{yes = 61, no = 0}



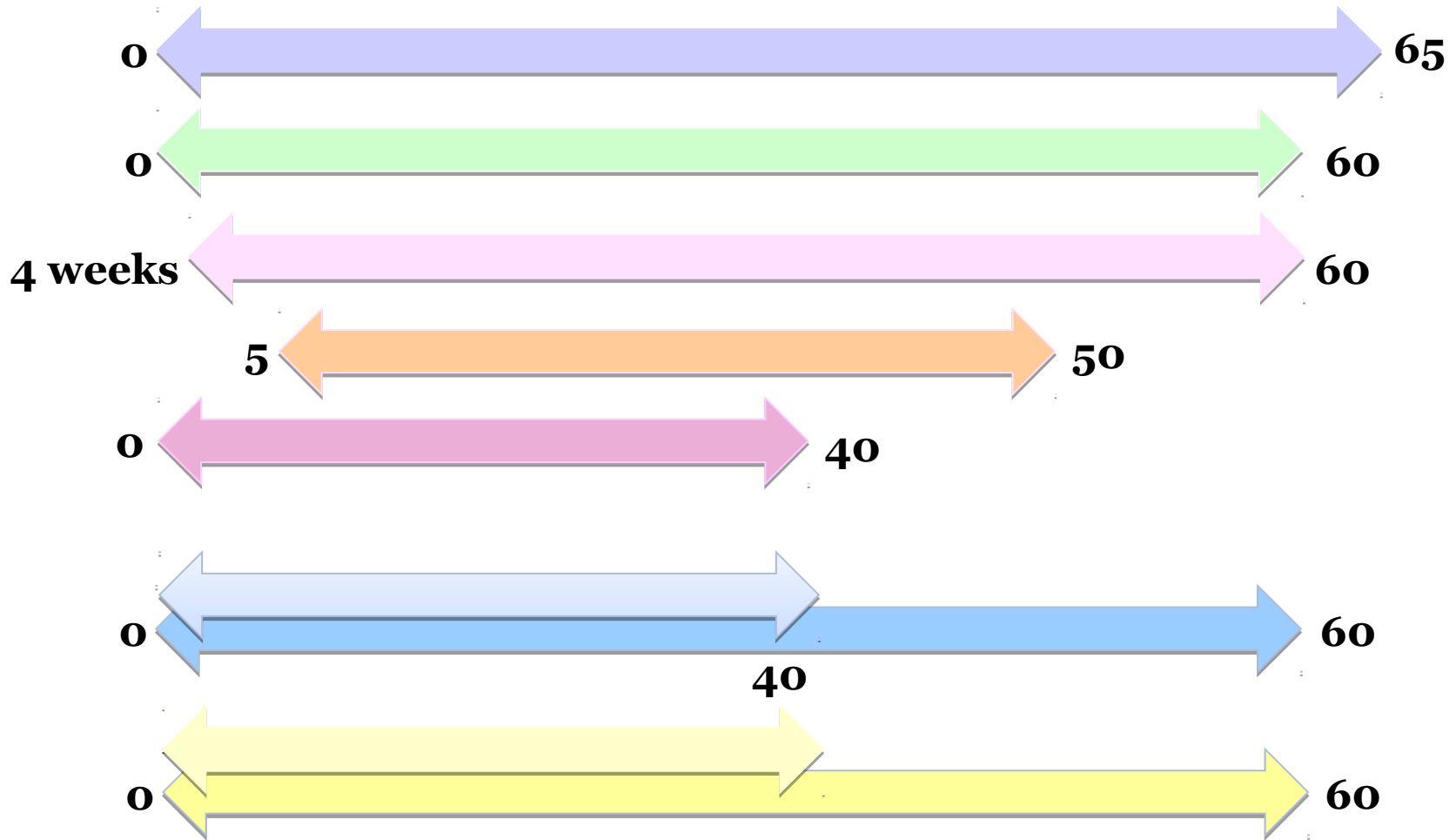
Exclusion Criteria

DRIVING	Any patient who has been fit free for a year Any patient that has had a single unprovoked seizure >6months ago and has a licence Any patient who has had their driving licence withdrawn or surrendered as a result of a clinical incident Any patient who is still driving and has been referred for investigation of epilepsy
EYE CONDITIONS	Detachment of retina Recent eye surgery Photophobia Migraine Keratitis Dilating eye drops Albino
PATIENT STATE	Patients who are not able to cooperate Patients who decline/refuse Patients who are confused Patients who are in pain Patients who are unwell Patient who express concerns

continued....

EEG FINDINGS	EEG in keeping with non-convulsive status (or if patient has recently been in non-convulsive status) Frequent or almost continuous paroxysmal discharges
OTHER	Any patient who is pregnant Any patient whose referring Consultant has specifically asked for photic stimulation not to be performed Any patient who is being investigated for delirium, headaches, psychosis, stroke or head injury Any patient on the ward Any patient who has not had a routine EEG Any patient who has been sleep deprived Any patient who has previously had photic stimulation as an adult

Inclusion Criteria for Age



Specific Inclusion Criteria

- All patients specifically requested to have PS by the Consultant
- All patients whose referral or patient history suggests myoclonus
- Patients who have a history of seizures provoked by sunlight, TV, computers, a family history of visually induced seizures, presence of spike and wave in routine EEG
- All children <5 years old if history of regression of skills, myoclonic epilepsy, history of primary generalised epilepsy ? Battens, ALD or Gaucher disease
- Patients who are still driving and have been referred for investigation of epilepsy
- Any patient with idiopathic generalised epilepsy and clinical absences with 3Hz spike and wave

Environment and Equipment



Viasys photic stimulator
Grass photic stimulator
Nicolet Voyager system

Darken the room, dim the lighting but sufficient to see the patient, daylight excluded, uplighter used



Patient on bed with bed end raised



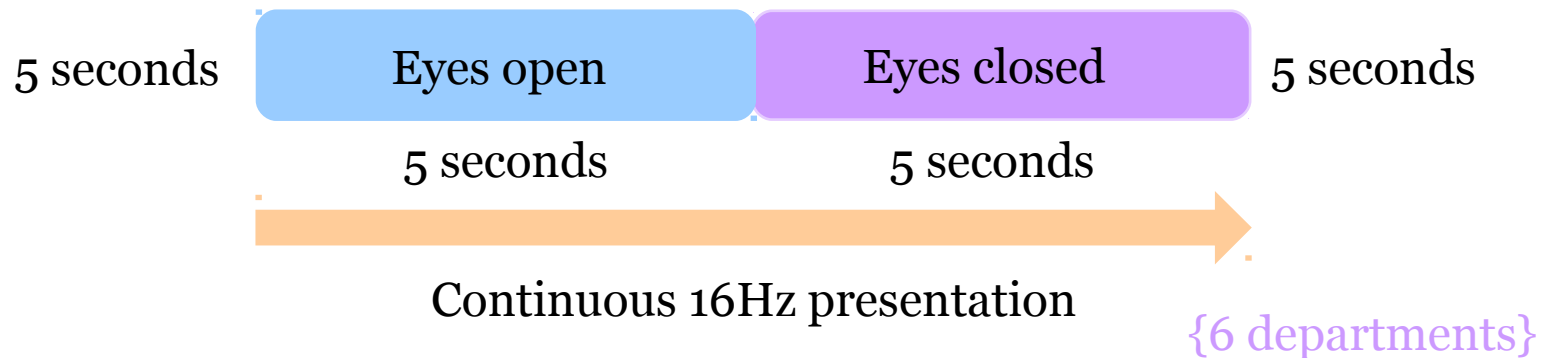
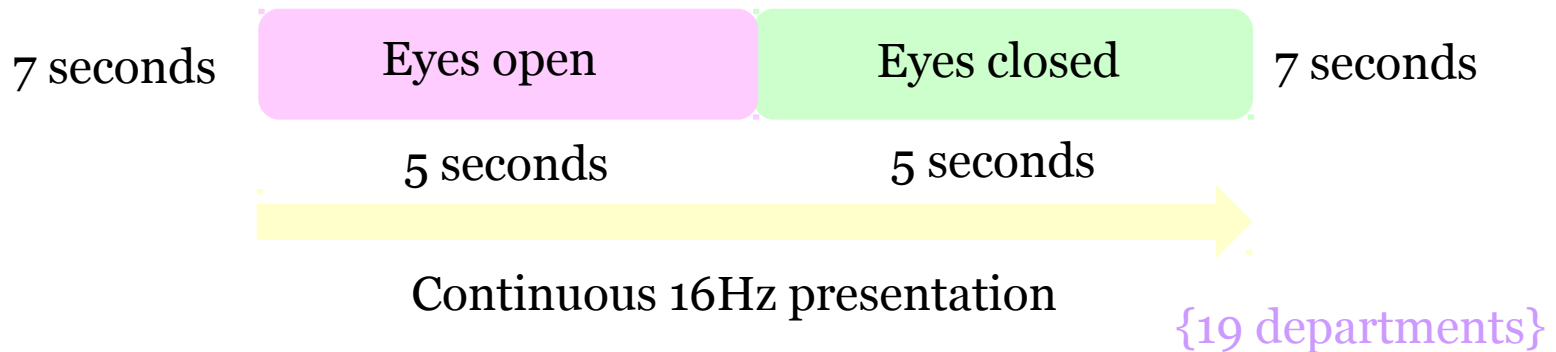
10-15cm, 20-30cm, 30cm
from patient's face/nasion
square on



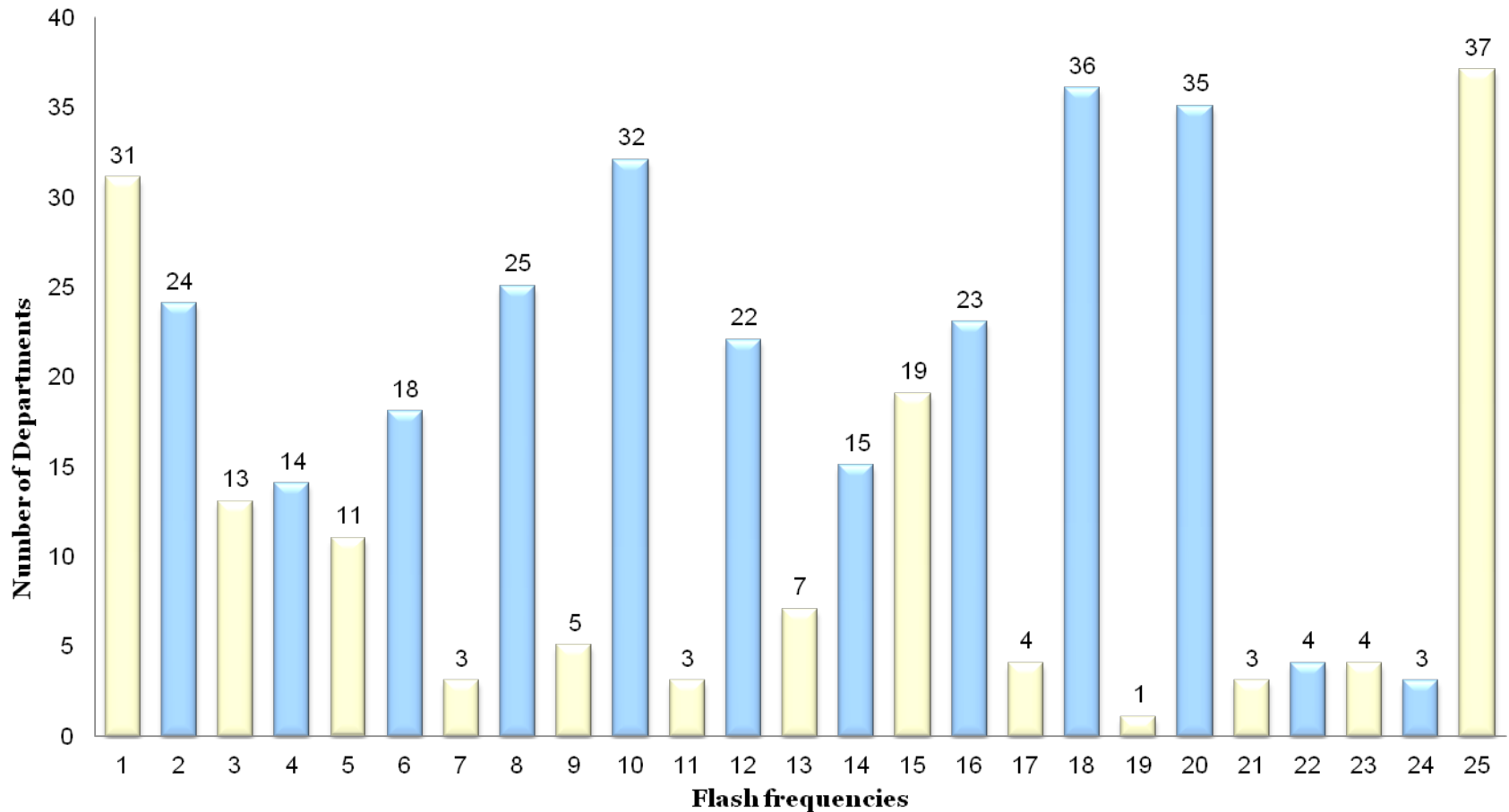
Maximum intensity >100 Nit-
s per flash, 15-20% intensity
level, Stimulus intensity at the
maximum
(7 = 0.190mJ/flash)

Procedure

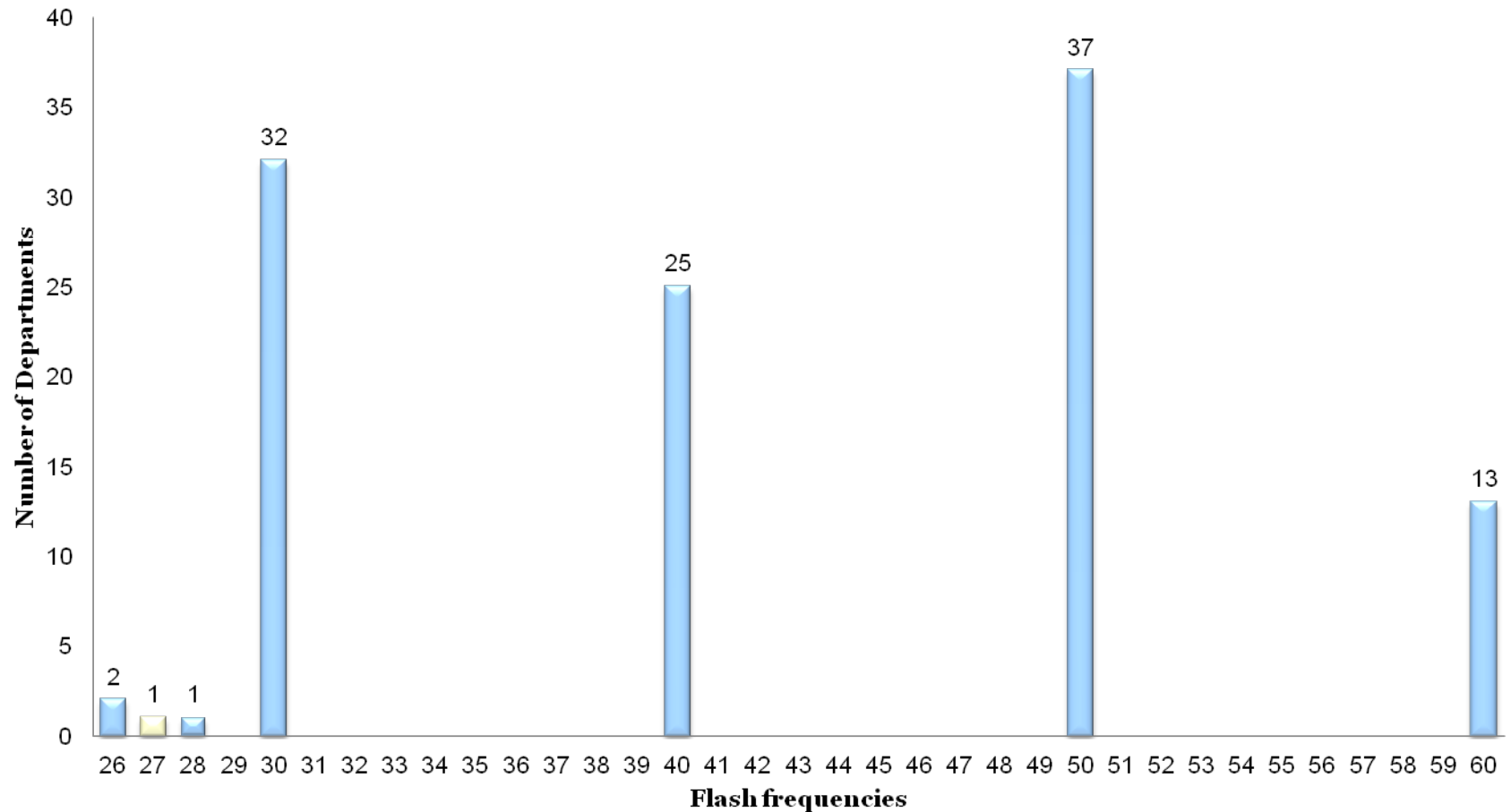
Diagrammatic of most popular procedures



Flash frequencies used in PS

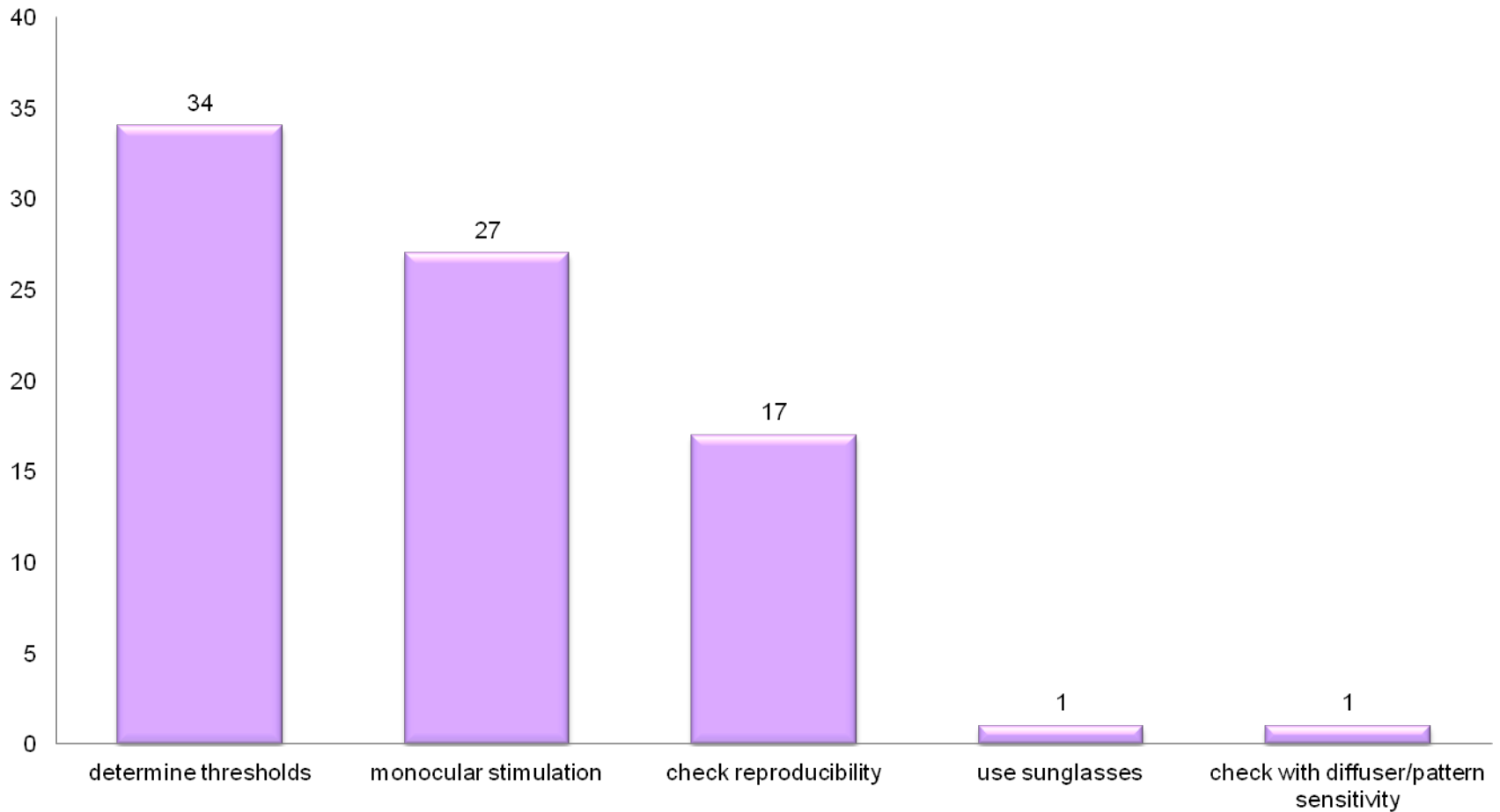


Flash frequencies used in PS



In the event of a PPR

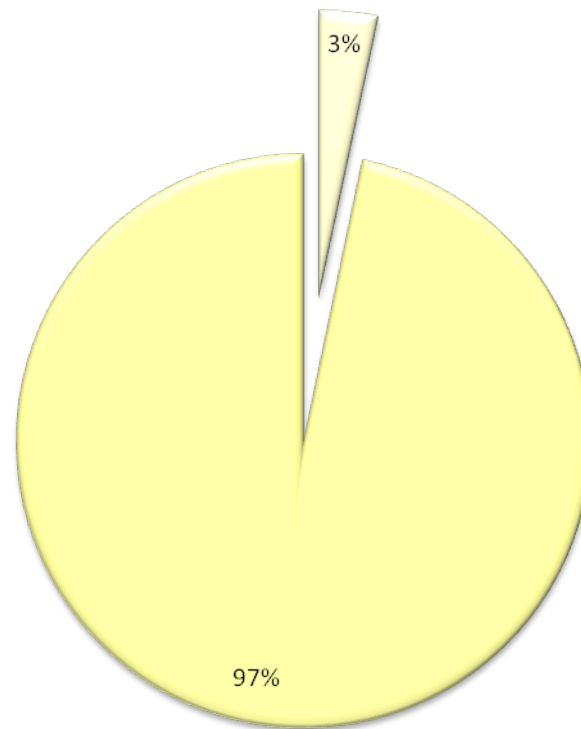
STOP!!!



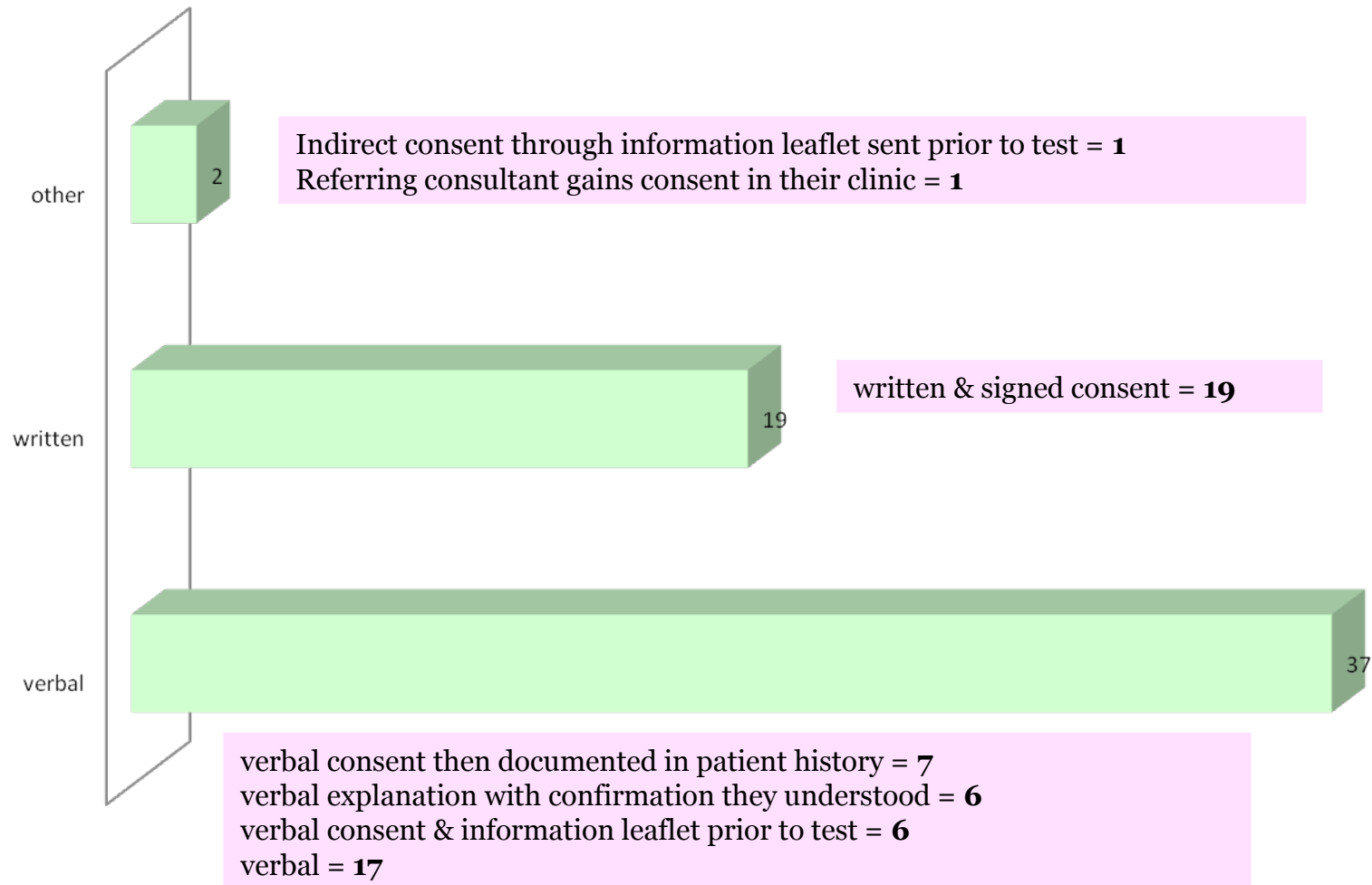
Do you obtain consent for photic stimulation?

{yes = 59, no = 2}

no yes

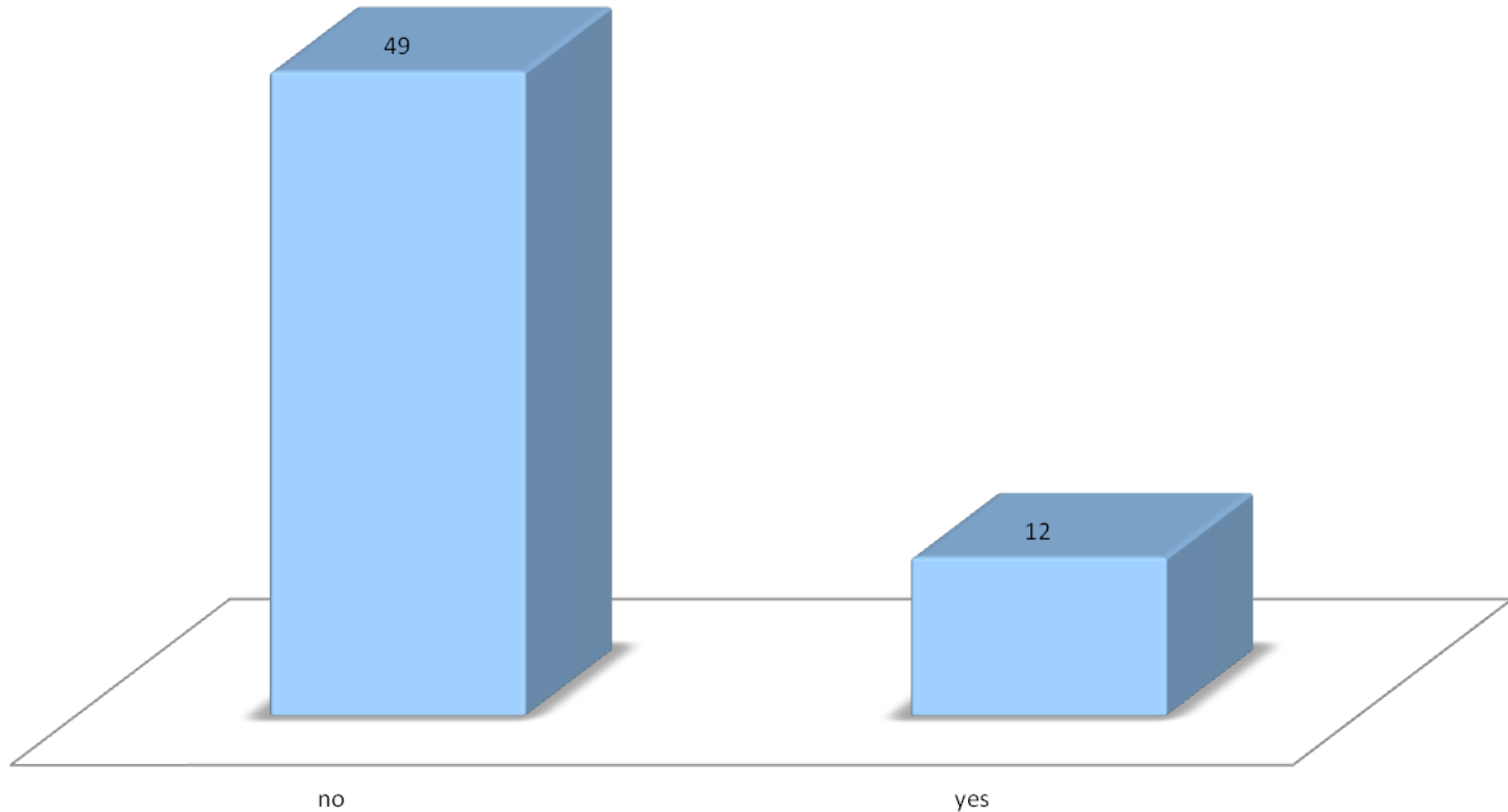


If you do obtain consent, please provide details of your method used



Have you ever performed a local or regional audit on the safety and/or efficacy of photic stimulation?

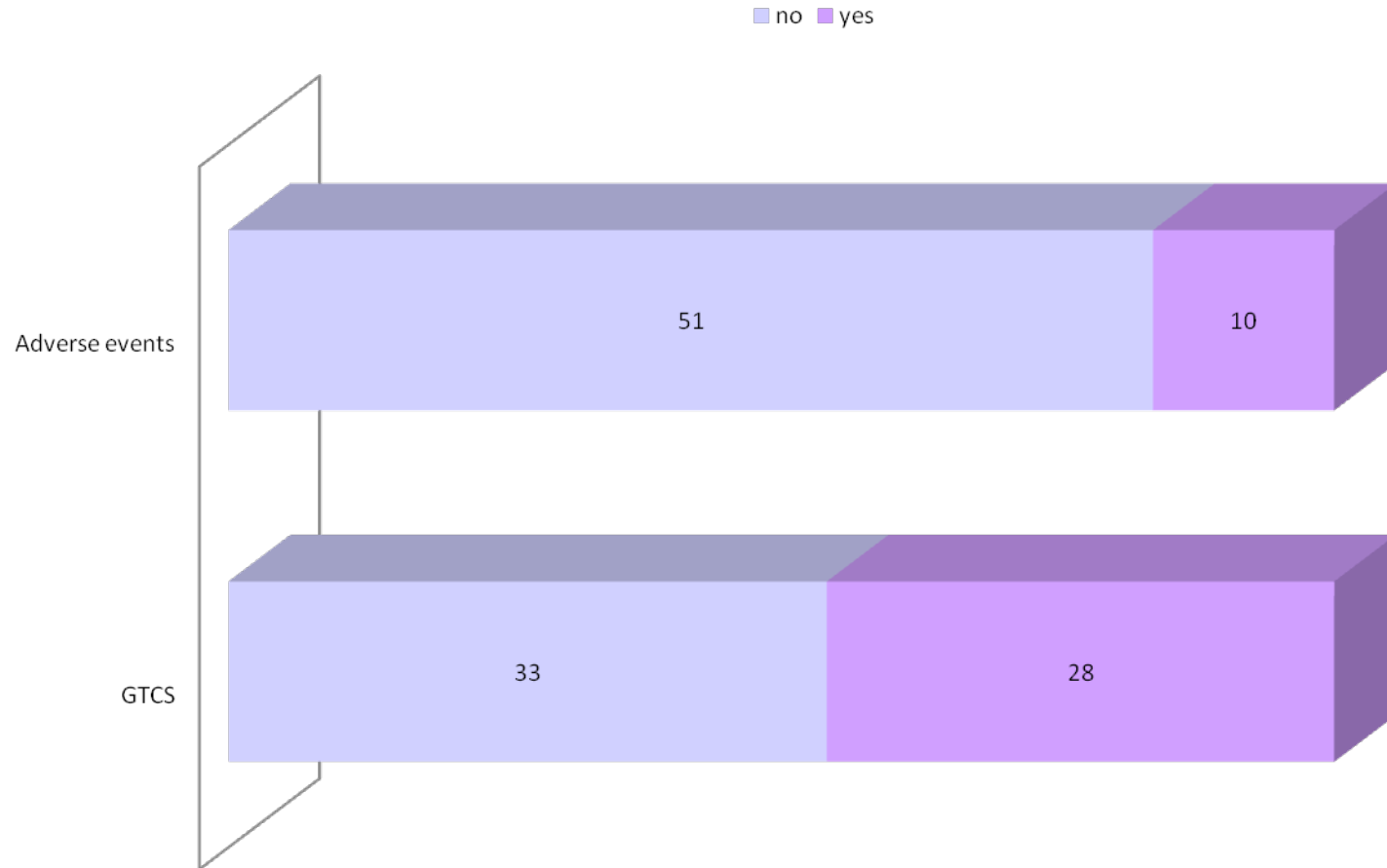
{yes = 12, no = 49}



Audits.....

- Detected the vulnerable groups of patients (primary generalised seizure disorder, GTCS, 14-30 years) and reduced the number of flash frequencies
- PS unnecessary in patients >60 years; not beneficial in >40 years
- Comparing Micromed and Grass stimulators – Grass strobe more potent stimulus
- Adherence rate to protocol – 100%
- Monocular stimulation? Frequency range? 1/6 neurologists use monocular, all use frequency range to aid guidance (n=6) however in another audit, 85% not interested in frequency range

Do you recall any GTCS or adverse events during photic stimulation in your department?



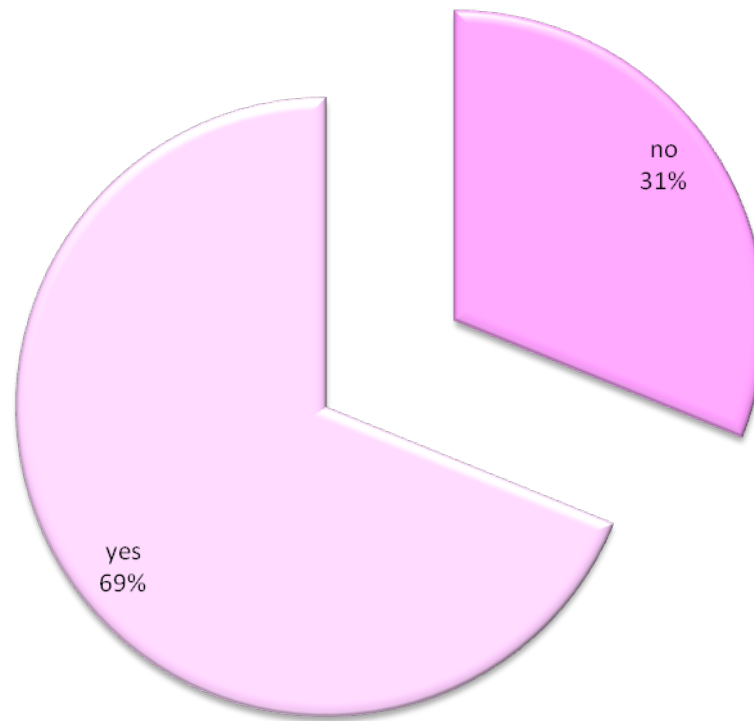
Adverse events and changes in practice

- Patient feeling unwell
- Migraine
- Panic attack/hysteria
- Photophobia
- Various seizures evoked: NEAs, myoclonic jerks, absences, complex partials

Changes in practice? – safety and status guidelines in place, hands free phone in the room, reduced frequencies

Do you have a protocol for dealing with seizures?

{yes = 42, no = 19}



Summary

- Around half the departments use published guidelines
- All have a departmental protocol
- Variability exists in respects of the procedure, age groups and consent
- Safety: around half the departments have experienced GTCS but no real other adverse events. Only two thirds have protocols for dealing with seizures



The Safety and Efficacy of Photic Stimulation during EEG

Kimberley Whitehead

10th October 2014

Why?

Method

- Form B was completed prospectively by each department for each consecutive patient attending for conventional EEG (sleep-deprived recordings were not included) between 1st Nov and 31st Dec 2013.
- Data collected at time of EEG reporting.

Form B

Postcode of Centre (Please complete)		Local EEG number (Please complete)		Project code (Do not complete - for office use only)	
1. What is the age of the patient?					
2. What is the gender of the patient?				M /F	
3. What was the referral diagnosis?				Epilepsy Non-Epileptic Attack Disorder (NEAD) Epilepsy and/or NEAD Other	
4. Did a clinical attack occur spontaneously during the resting record or provoked by Hyperventilation (HV)?				Yes / No	
5. Was Photic Stimulation (PS) performed? If 'yes' proceed to question 7 and continue the questionnaire If 'no' answer question 6 only				Yes / No	
6. Why was Photic Stimulation not performed?				Previously demonstrated photosensitivity Age: patient too old for PS to be valuable Age: patient too young to cooperate Insufficient cooperation from patient Sleep deprived Patient refused Against dept protocol (not listed above) Other	
7. How long after the end of HV was PS performed (in minutes)?					
8. Did PS provoke a clinical seizure?				Yes / No	
9. If 'yes' was it: If 'Epileptic' please answer questions 10, 11 and 12. If 'Non- Epileptic' please proceed to question 12				An Epileptic seizure A Non-Epileptic Attack	
10. If an Epileptic seizure was precipitated by PS was it:				Generalised Focal	
11. Please describe precise Epileptic seizure type :				Generalised Tonic Clonic Seizure Generalised (limb or body) Myoclonus Eyelid Myoclonus	

Results

- 71 UK centres responded
- 6807 patients
- 49% female
- Age range 0-99 years, median 28 years
- **5383 patients underwent PS (79.1%)**

Reasons PS omitted

- 20.9% patients did not undergo PS
- In those cases in which a reason was provided:
 - ‘Other’ (33%)
 - ‘Patient too old’ (23%)
 - ‘Insufficient cooperation’ (18%)
 - ‘Patient too young’ (9%)
 - ‘Against department protocol’ (9%)

Timing

- PS was most commonly performed three minutes after the cessation of HV although in 8% of cases it was done one or two minutes after the end of HV.

Outline of key results

- Patients with PPR (without clinical correlates)
- Patients with attacks/seizures
 - Safety of PS re risk of GTCS
- Overall efficacy of PS in eliciting new information (PPR and/or attacks/seizures)
- Effect of AED use and age on PS

PPR

- Of 5383 pts that underwent PS, during the procedure 1.9% (102 patients) had unequivocal generalised epileptiform activity (PPR), not previously seen in the resting record, without clinical concomitants.
- These patients ranged in age from 1-65 years (median 15 years) and were 57% female.

Attacks/seizures

- PS provoked attacks in 1.7% (90 patients).
- 44% (forty patients) had epileptic seizures (ES); remainder (56%) had NEAs.
- ES pts had a median age of 13 years and were 68% female; Pts with NEAs had a median age of 31 years and were 61% female.

Epileptic seizure types

- 3 ES were focal
 - Two were unclassified and the other was focal myoclonus
- 37 ES were generalised
 - Most often myoclonus (40%) or absence (27.5%)

Safety re. GTCS

- Of the generalised seizures, three were GTCS giving a risk of PS eliciting a GTCS of **0.06%** (equivalent to 1 patient in 1794).
- The GTCS patients were: two females aged 9 and 13 years respectively and one male aged 25 years. The 9 year old girl was not taking AEDs but the other two patients were.

Efficacy

102 patients with
PPR



14 pts who had
already had
clinical attacks
prior to PS

88 pts in whom
PPR during PS
was the only
diagnostically
useful info

90 patients with attacks
during PS



51 pts included
in whom the
attack during PS
was the only
diagnostically
useful info

39 pts who had
already had
clinical attacks
prior to PS

102 patients with
PPR

90 patients with attacks
during PS

14 pts who had
already had
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88 pts in whom
PPR during PS
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51 pts included
in whom the
attack during PS
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diagnostically
useful info

39 pts who had
already had
clinical attacks
prior to PS

A total of 139 patients (2.6%) of
those who underwent PS benefited
from PS providing new, useful
clinical information

2.6% of those who underwent PS
(all ages) benefited from PS
providing new, useful clinical
information



3.1% of ≤ 17 years



1.5% of > 18 years

Effect of taking AEDs

- In patients not taking any AEDs who underwent PS, 1.9% (78/4030) had a PPR and 0.7% (29/4030) had an ES.
- In patients taking AEDs who underwent PS, 1.8% (24/1353) had a PPR and 0.7% (10/1353) had an ES.

Effect of young age

- The youngest child that had a PPR was one year old and the youngest child having an attack triggered by PS was two years old.

Effect of advanced age

- One of the pts who had a PPR was over 60 (65 years) and the DD was ?epilepsy but not taking AEDs.
- Of those pts that had an attack elicited by PS, four were over 60 (two 66, one 67 and one 71) and none had had clinical attacks previously in the EEG.
- The 67 year old had epileptic generalised myoclonus and the other three had NEAs. Of the three that had NEAs, two had a differential diagnosis of 'epilepsy and/or NEAD' and were taking antiepileptic drugs.

Discussion

- PS is safe (TCS 0.06%) and moderately effective at eliciting new information (PPR/attacks)
- Based on this audit, age should not be a reason to exclude patients from undergoing PS

Possible standards and guidelines

Key issues: Consent, SOP and analysis of response to PS

- Standard 1: Must have a protocol for PS.
- Standard 2: Must have a protocol for dealing with seizures.
- Standard 3: PS should be performed in all age groups.
- Standard 4: PS should be performed in those who have had a NEA earlier in the EEG.
 - Guideline: PS should be performed in those who have had an epileptic seizure earlier in the EEG too (to help with syndrome classification)
- Standard 5: Informed consent (with reference to the exact risk of GTCS) to be properly documented.
- Standard 6: Each flash must contain eye closure. If epileptiform change, report must specify whether generalised. Reproducibility of PPR should be demonstrated with the minimum stimuli necessary (does not need to be at the same flash frequency).
- Standard 7: Children suspected of progressive myoclonic epilepsies should undergo $\leq 5\text{Hz}$ flash frequencies.
- If PS is not done, it should be clearly documented exactly why it was not performed.