

# NeuroTrace Study Guide

**Domain:** Domain III – EEG Patterns & Clinical Correlation

**Section:** EEG Activation Procedures

**Style:** Mechanism-based, exam-focused, clinical

---

## 1. Core Principles (Must Know)

### Activation Procedures Alter Cortical Excitability

- **Activation procedures alter cortical excitability**
- They modify brain activity to enhance diagnostic yield
- Different procedures affect different brain regions
- Purpose is to provoke or enhance abnormalities

### They Increase EEG Diagnostic Sensitivity

- **They increase EEG diagnostic sensitivity**
- Help detect abnormalities that may not be visible at rest
- Enhance interictal epileptiform discharges
- Improve diagnostic accuracy

### Responses May Be

#### Normal Physiologic

- **Normal physiologic responses:** Expected, non-pathologic changes
- Examples: HV-induced slowing, photic driving
- Do not indicate pathology
- Must be recognized as normal

#### Abnormal Epileptiform

- **Abnormal epileptiform responses:** Pathologic, indicate seizure risk
- Examples: HV-induced spike-and-wave, photic-induced discharges
- Indicate increased seizure risk
- Require clinical correlation

#### Key Principle

- **Activation enhances abnormalities; it does not create epilepsy**
- Activation reveals existing abnormalities
- Does not cause epilepsy
- Negative activation does not exclude epilepsy

#### Practical Application

- Always perform activation procedures when appropriate
  - Recognize normal vs abnormal responses
  - Document activation responses accurately
  - Correlate with clinical presentation
- 

## 2. Hyperventilation (HV)

### Physiologic Effects

## Mechanism

- ↓ CO<sub>2</sub> → **cerebral vasoconstriction**
- Hyperventilation reduces CO<sub>2</sub> (hypocapnia)
- Causes cerebral vasoconstriction
- Reduces cerebral blood flow

## Result

- **Produces generalized slowing (especially children)**
- Generalized theta/delta activity
- More prominent in children
- Usually symmetric

## Normal EEG Response

### Characteristics

- **Symmetric, generalized theta/delta**
- Bilateral, symmetric slowing
- Generalized distribution
- No epileptiform discharges

### Timing

- **Resolves after HV ends**
- Slowing appears during HV
- Resolves within 1-2 minutes after stopping
- Background returns to baseline

### Age Considerations

- **More prominent in children:** Children show more slowing
- **Less prominent in adults:** Adults show less slowing
- **Age-dependent:** Response varies with age
- **Normal variant:** HV-induced slowing is normal

## Abnormal Response

### Generalized Spike-and-Wave (Absence Epilepsy)

- **3 Hz spike-and-wave:** Classic pattern for absence epilepsy
- **Generalized distribution:** Bilateral, synchronous
- **Frontal predominance:** Often frontally predominant
- **Clinical significance:** Suggests absence epilepsy

### Other Abnormal Patterns

- **Focal epileptiform:** May enhance focal discharges
- **Asymmetric slowing:** May indicate focal pathology
- **Persistent slowing:** May indicate encephalopathy

## ABRET Emphasis

- **HV-induced slowing in children is usually normal**
- Must not be called abnormal in children
- Only epileptiform responses are abnormal
- Age-appropriate interpretation is critical

## Safety Considerations

- **Contraindications:** Sickle cell disease, severe cardiac disease, severe respiratory disease
  - **Duration:** Usually 3-5 minutes
  - **Monitoring:** Watch for patient distress
  - **Stop if:** Patient becomes uncomfortable or shows signs of distress
- 

### 3. Photic Stimulation (IPS)

#### Physiologic Response

##### Photic Driving

- **Occipital rhythm time-locked to flash rate**
- Occipital rhythm follows flash frequency
- Time-locked to flash rate (1:1 or harmonics)
- Symmetric and posterior dominant

##### Characteristics

- **Symmetric and posterior dominant**
- Bilateral, symmetric response
- Maximal over occipital regions
- Normal physiologic response

#### Frequency Response

- **1:1 driving:** Occipital rhythm matches flash rate
- **Harmonic driving:** Occipital rhythm at multiples of flash rate
- **Subharmonic driving:** Occipital rhythm at fractions of flash rate
- **Normal variants:** All are normal

#### Abnormal Response

##### Photic-Induced Epileptiform Discharges

- **Spikes or spike-and-wave:** Epileptiform discharges during photic
- **Time-locked to flash:** Discharges occur during photic stimulation
- **Generalized or focal:** May be generalized or focal
- **Clinical significance:** Indicates photosensitive epilepsy

##### Photosensitive Epilepsy Patterns

- **Generalized spike-and-wave:** Most common pattern
- **Polyspike-and-wave:** Less common pattern
- **Focal discharges:** May occur in some cases
- **Clinical correlation:** Correlates with photosensitive seizures

#### ABRET Trap

- **Photic driving ≠ photic-induced epilepsy**
- Photic driving is normal
- Photic-induced epileptiform is abnormal
- Must differentiate between the two

#### Technique

- **Flash rates:** Usually 1-30 Hz
- **Duration:** Usually 10 seconds per frequency
- **Eyes closed:** Usually performed with eyes closed

- **Documentation:** Must document responses at each frequency
- 

## 4. Sleep & Sleep Deprivation

### Sleep Increases

#### Interictal Epileptiform Discharges

- **Sleep increases interictal epileptiform discharges**
- More discharges seen in sleep than wake
- Especially in light sleep (Stage 1-2)
- Important for focal epilepsy

#### Mechanism

- **Sleep enhances cortical excitability**
- Sleep stages affect cortical activity
- Light sleep is most activating
- Deep sleep may suppress some discharges

### Sleep Deprivation

#### Enhances Diagnostic Yield

- **Sleep deprivation enhances diagnostic yield**
- Increases likelihood of capturing abnormalities
- Improves sleep quality during recording
- Common in focal epilepsy

#### Common in Focal Epilepsy

- **Common in focal epilepsy**
- Especially temporal lobe epilepsy
- Helps capture interictal discharges
- Improves diagnostic sensitivity

### Sleep Stages and Activation

- **Light sleep (Stage 1-2):** Most activating
- **Deep sleep (Stage 3-4):** May suppress some discharges
- **REM sleep:** Variable effects
- **Sleep transitions:** Often show increased activity

### Clinical Application

- **Always attempt sleep:** If clinically indicated
  - **Sleep deprivation:** Consider if initial EEG negative
  - **Document sleep stages:** Important for interpretation
  - **Correlate with clinical:** Sleep-activated discharges are significant
- 

## 5. Activation vs Artifact

Feature	Activation Effect	Artifact
<b>Time-locked</b>	Yes	Often irregular
<b>Symmetry</b>	Usually symmetric	Variable

<b>Reversibility</b>	Yes	Inconsistent
<b>Distribution</b>	Physiologic	Non-physiologic
<b>Clinical correlation</b>	Yes	No
<b>Reproducibility</b>	Reproducible	Variable

## Key Distinctions

### Time-Locked

- **Activation effect:** Time-locked to procedure (HV, photic)
- **Artifact:** Often irregular, not time-locked
- **Timing:** Activation effects occur during/after procedure
- **Pattern:** Activation effects follow predictable patterns

### Symmetry

- **Activation effect:** Usually symmetric (bilateral)
- **Artifact:** Variable symmetry
- **Distribution:** Activation effects are physiologic
- **Consistency:** Activation effects are consistent

### Reversibility

- **Activation effect:** Reversible (stops when procedure stops)
- **Artifact:** May persist or be inconsistent
- **Resolution:** Activation effects resolve after procedure
- **Persistence:** Artifacts may persist

## 6. Common ABRET Exam Traps

### Trap 1: Calling HV-Induced Slowing Abnormal in Children

- **Reality:** HV-induced slowing is normal in children
- **Trap:** May call normal slowing as abnormal
- **Solution:** Recognize that HV-induced slowing is normal
- **ABRET focus:** Age-appropriate interpretation

### Trap 2: Confusing Photic Driving with Epileptiform Response

- **Reality:** Photic driving is normal, epileptiform is abnormal
- **Trap:** May call photic driving as epileptiform
- **Solution:** Look for epileptiform morphology (spikes, spike-and-wave)
- **ABRET focus:** Differentiation of normal vs abnormal

### Trap 3: Ignoring State and Age

- **Reality:** Activation responses vary with age and state
- **Trap:** May not consider age or state when interpreting
- **Solution:** Always consider age and state
- **ABRET focus:** Context-dependent interpretation

### Trap 4: Overcalling Activation-Related Changes

- **Reality:** Not all activation-induced changes are abnormal
- **Trap:** May call normal activation responses as abnormal

- **Solution:** Learn normal activation responses
- **ABRET focus:** Recognition of normal responses

### Trap 5: Not Documenting Activation Responses

- **Reality:** Activation responses must be documented
  - **Trap:** May not document activation responses
  - **Solution:** Always document activation responses
  - **ABRET focus:** Proper documentation
- 

## 7. Clinical Correlation

### Activation Procedures Aid Syndrome Classification

- **Activation procedures aid syndrome classification**
- Help classify epilepsy syndromes
- Guide treatment decisions
- Improve diagnostic accuracy

#### Examples

- **HV-induced 3 Hz spike-and-wave:** Absence epilepsy
- **Photic-induced discharges:** Photosensitive epilepsy
- **Sleep-activated discharges:** Focal epilepsy
- **Sleep deprivation:** Temporal lobe epilepsy

### Negative Activation Does Not Exclude Epilepsy

- **Negative activation does not exclude epilepsy**
- Normal activation does not rule out epilepsy
- Must correlate with clinical presentation
- Consider other diagnostic tests

### Safety Considerations Must Be Followed

- **Safety considerations must be followed**
- Contraindications must be respected
- Patient monitoring is essential
- Stop if patient becomes distressed

### Contraindications

- **HV:** Sickle cell disease, severe cardiac/respiratory disease
- **Photic:** Known photosensitive epilepsy (with caution)
- **Sleep deprivation:** Severe sleep disorders, certain medications

### Best Practice

- Always perform activation when appropriate
  - Recognize normal vs abnormal responses
  - Document activation responses accurately
  - Correlate with clinical presentation
- 

## 8. Case-Based Example

### Scenario

**Clinical Setting:** Routine EEG for staring spells

**EEG Finding:** Generalized spike-and-wave during HV

**Clinical History:** Brief staring spells, normal development

**Pattern:** 3 Hz generalized spike-and-wave, frontally predominant, during HV

### Interpretation

- **Suggestive of absence epilepsy**
- HV-induced 3 Hz spike-and-wave
- Generalized distribution
- Consistent with absence epilepsy

### Teaching Point

- **HV is particularly useful in generalized epilepsies**
- HV enhances generalized epileptiform discharges
- 3 Hz spike-and-wave is classic for absence epilepsy
- Activation helps confirm diagnosis

### ABRET Application

- Given HV-induced spike-and-wave → recognize as abnormal
- Given 3 Hz frequency → think absence epilepsy
- Given generalized distribution → think generalized epilepsy
- Must correlate with clinical presentation

---

## 9. Exam Readiness Checklist

Use this checklist to verify your understanding:

- Can identify normal HV response (symmetric slowing)
- Can recognize photic driving (normal response)
- Can differentiate abnormal activation patterns (epileptiform)
- Can apply age-specific interpretation (children vs adults)
- Understand that HV-induced slowing is normal in children
- Know that photic driving is normal, epileptiform is abnormal
- Recognize that sleep enhances diagnostic yield
- Understand that activation enhances, doesn't create, abnormalities
- Know that negative activation doesn't exclude epilepsy
- Can identify common ABRET exam traps
- Understand safety considerations
- Know that activation procedures aid syndrome classification

---

## 10. Internal Cross-Links

### Patterns

- **Epileptiform Discharges:** Activation may enhance epileptiform activity
- **Diffuse Slowing:** HV may produce diffuse slowing
- **Sleep & Graphoelements:** Sleep is an activation procedure

### Workflow

- **Recording Procedures:** How to perform activation procedures
- **Safety & Ethics:** Safety considerations for activation

## Cases

- **Absence epilepsy cases:** Cases with HV-induced spike-and-wave
- **Photosensitive epilepsy cases:** Cases with photic-induced discharges
- **Sleep-activated cases:** Cases with sleep-activated discharges

## Quizzes

- **Activation procedure MCQs:** Questions on activation procedures
  - **Normal vs abnormal responses:** Questions on differentiation
  - **Age-specific interpretation:** Questions on age considerations
- 

## Study Tips

1. **Memorize normal responses:** HV-induced slowing (normal), photic driving (normal)
  2. **Learn abnormal patterns:** HV-induced spike-and-wave, photic-induced epileptiform
  3. **Understand mechanisms:** HV (vasoconstriction), photic (driving), sleep (enhanced excitability)
  4. **Know age differences:** Children show more HV-induced slowing
  5. **Remember the principle:** Activation enhances, doesn't create, abnormalities
  6. **Know the traps:** Calling normal responses abnormal, ignoring age/state
  7. **ABRET focus:** Expect questions on normal vs abnormal responses and age-specific interpretation
- 

## End of Study Guide

*For additional practice, complete quiz questions tagged: hyperventilation, photic, sleep, activation, photosensitivity*