

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
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2. Hyperventilation (HV)

Physiologic Effects

Mechanism

- ↓ CO₂ → **cerebral vasoconstriction**
- Hyperventilation reduces CO₂ (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
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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 \neq 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
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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
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5. Activation vs Artifact

Feature	Activation Effect	Artifact
Time-locked	Yes	Often irregular
Symmetry	Usually symmetric	Variable

Reversibility	Yes	Inconsistent
Distribution	Physiologic	Non-physiologic
Clinical correlation	Yes	No
Reproducibility	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
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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
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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
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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
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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
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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
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End of Study Guide

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