NeuroTrace Study Guide

Domain: Domain II – EEG Procedures & Data Acquisition
Section: Filters, Sensitivity & Time Constants
Style: Cause–effect, exam-oriented, applied

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1. Core Principles (Must Know)

Filters Modify Signal Frequencies Displayed

- **Filters modify signal frequencies displayed**
- Low-frequency filter (LFF): Removes slow frequencies
- High-frequency filter (HFF): Removes fast frequencies
- Filters shape what is visible
- Do not change brain activity

Sensitivity Controls Vertical Amplitude Scaling

- **Sensitivity controls vertical amplitude scaling**
- Measured in μV/mm
- Lower number = higher sensitivity (larger display)
- Higher number = lower sensitivity (smaller display)
- Does not change actual amplitude

Improper Settings Distort EEG Interpretation

- **Improper settings distort EEG interpretation**
- High LFF: Masks slow waves
- Low HFF: Masks spikes
- Wrong sensitivity: May miss abnormalities
- Must use correct settings

Key Principle

- **Technical settings affect appearance, not brain activity**
- Settings change display, not brain
- Must verify settings before interpreting
- Settings can create false appearances
- Always check settings first

Practical Application

- Always verify filter and sensitivity settings
- Understand how settings affect appearance
- Use appropriate settings for clinical scenario
- Document settings in report

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2. Low-Frequency Filter (LFF)

Controls Slow-Frequency Cutoff

- **Controls slow-frequency cutoff:** Removes frequencies below cutoff
- Typical setting: 0.1–0.3 Hz (routine)
- May be set higher for specific purposes
- Lower LFF = more slow activity visible

- Higher LFF = less slow activity visible

Typical Setting: 0.1–0.3 Hz

- **Typical setting: 0.1–0.3 Hz (routine)**
- Allows delta activity to be seen
- Prevents excessive baseline drift
- Standard for routine EEG
- May be adjusted for specific needs

Effects of Raising LFF

Attenuates Delta

- **Attenuates delta:** Reduces delta activity visibility
- Delta activity becomes smaller
- May disappear entirely
- Can mask pathologic slowing
- Critical for encephalopathy detection

Masks Diffuse Slowing

- **Masks diffuse slowing:** Can hide encephalopathy
- Diffuse slowing may not be visible
- EEG may appear normal
- False-negative interpretation
- Critical error

Flattens Baseline Drift

- **Flattens baseline drift:** Reduces baseline movement
- Baseline appears more stable
- May be desirable for some recordings
- But may hide important slow activity
- Trade-off between stability and visibility

ABRET Emphasis

- **High LFF can falsely normalize encephalopathy**
- Encephalopathy may not be visible
- EEG may appear normal
- False interpretation
- Must check LFF before interpreting

Best Practice

- Use low LFF (0.1–0.3 Hz) for routine
- Check LFF before interpreting
- Know that high LFF masks slowing
- Document LFF in report

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3. High-Frequency Filter (HFF)

Controls Fast-Frequency Cutoff

- **Controls fast-frequency cutoff:** Removes frequencies above cutoff
- Typical setting: 35–70 Hz (routine)
- May be set lower for artifact reduction

- Higher HFF = more fast activity visible
- Lower HFF = less fast activity visible

Typical Setting: 35–70 Hz

- **Typical setting: 35–70 Hz (routine)**
- Allows spikes to be seen
- Reduces muscle artifact
- Standard for routine EEG
- May be adjusted for specific needs

Effects of Lowering HFF

Attenuates Spikes

- **Attenuates spikes:** Reduces spike visibility
- Spikes become smaller
- May be missed
- Can mask epileptiform activity
- Critical for epilepsy detection

Smooths Sharp Waves

- **Smooths sharp waves:** Makes sharp waves less sharp
- Sharp waves become rounded
- May be missed or misidentified
- Can mask epileptiform activity
- Critical error

Reduces Muscle Artifact

- **Reduces muscle artifact:** May be desirable
- Muscle artifact becomes smaller
- May improve signal quality
- But may also hide spikes
- Trade-off between artifact and signal

ABRET Trap

- **Excessively low HFF can hide epileptiform activity**
- Spikes may not be visible
- Epileptiform activity may be missed
- False-negative interpretation
- Must check HFF before interpreting

Best Practice

- Use appropriate HFF (35–70 Hz) for routine
- Check HFF before interpreting
- Know that low HFF masks spikes
- Document HFF in report

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4. Sensitivity (Gain)

Measured in µV/mm

- **Measured in µV/mm:** Standard unit
- Lower number = higher sensitivity

- Higher number = lower sensitivity
- Typical: 7.5–10 μV/mm (routine)
- May be adjusted for specific needs

Lower Number = Higher Sensitivity

- **Lower number = higher sensitivity:** Important concept
- 5 μV/mm = higher sensitivity (larger display)
- 10 μV/mm = lower sensitivity (smaller display)
- Must understand this relationship
- Common ABRET trap

Effects

High Sensitivity

- **High sensitivity (lower μV/mm):**
- **Larger waveforms:** Everything appears larger
- **Increased artifact visibility:** Artifacts more prominent
- **Better for low-amplitude signals:** Small signals more visible
- **May be too sensitive:** Can be overwhelming

Low Sensitivity

- **Low sensitivity (higher μV/mm):**
- **Smaller waveforms:** Everything appears smaller
- **Possible loss of detail:** Small signals may be missed
- **Reduced artifact visibility:** Artifacts less prominent
- **May miss abnormalities:** Important findings may be missed

Best Practice

- Use standard sensitivity (7.5–10 μV/mm) for routine
- Adjust for specific needs
- Understand sensitivity effects
- Document sensitivity in report

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5. Time Constants (Analog Concept)

Relates to LFF Behavior

- **Relates to LFF behavior:** Analog equivalent
- Time constant determines LFF behavior
- Short time constant = high LFF
- Long time constant = low LFF
- Understanding helps with filter concepts

Short Time Constant → Loss of Slow Activity

- **Short time constant → loss of slow activity**
- Similar to high LFF
- Slow activity is attenuated
- May mask pathologic slowing
- Must understand relationship

Long Time Constant → Baseline Instability

- **Long time constant → baseline instability**

- Similar to low LFF
- More slow activity visible
- Baseline may drift more
- Trade-off between visibility and stability

Best Practice

- Understand time constant concept
- Know relationship to LFF
- Apply to filter understanding
- Use for interpretation

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6. Filter Effects Summary Table

Setting Change	EEG Effect	Risk
Raise LFF	Loss of delta	Miss encephalopathy
Lower HFF	Smooth spikes	Miss epileptiform
Lower sensitivity	Smaller waves	Miss abnormalities
Raise sensitivity	Larger waves	Increased artifacts
Short time constant	Loss of slow activity	Miss slowing
Long time constant	Baseline drift	Stability issues

Key Distinctions

Filter vs Sensitivity

- **Filter:** Affects frequency content (what frequencies are visible)
- **Sensitivity:** Affects amplitude display (how large waveforms appear)
- Different effects
- Both important
- Must understand both

Best Practice

- Memorize filter effects
- Understand sensitivity effects
- Know risks of improper settings
- Always verify settings

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7. Common ABRET Exam Traps

Trap 1: Confusing Sensitivity with Amplitude

- **Reality:** Sensitivity is display setting, amplitude is signal property
- **Trap:** May think sensitivity changes actual amplitude
- **Solution:** Understand that sensitivity only affects display
- **ABRET focus:** Sensitivity vs amplitude distinction

Trap 2: Attributing Filter Effects to Pathology

- **Reality:** Filter effects are technical, not pathologic
- **Trap:** May call filter effects as abnormal
- **Solution:** Always check filter settings first
- **ABRET focus:** Technical vs pathologic distinction

Trap 3: Forgetting Default Settings

- **Reality:** Default settings are important reference
- **Trap:** May not know standard settings
- **Solution:** Memorize standard settings (LFF 0.1–0.3 Hz, HFF 35–70 Hz, Sensitivity 7.5–10 μV/mm)
- **ABRET focus:** Standard settings knowledge

Trap 4: Ignoring Filter Settings During Interpretation

- **Reality:** Filter settings affect interpretation
- **Trap:** May interpret without checking settings
- **Solution:** Always verify settings before interpreting
- **ABRET focus:** Settings verification

Trap 5: Not Understanding Sensitivity Relationship

- **Reality:** Lower number = higher sensitivity
- **Trap:** May confuse the relationship
- **Solution:** Memorize: lower μV/mm = higher sensitivity
- **ABRET focus:** Sensitivity relationship

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8. Case-Based Example

Scenario

Clinical Setting: ICU EEG for encephalopathy
Problem: EEG appears normal despite clinical encephalopathy
Observation: No slowing visible on EEG
Question: What could cause this?

Hidden Issue

- **LFF set too high**
- LFF may be set at 5 Hz or higher
- Slow activity is being filtered out
- Encephalopathy not visible
- False-normal appearance

Correct Action

- **Lower LFF and reassess**
- Lower LFF to 0.1–0.3 Hz
- Reassess EEG for slowing
- Encephalopathy may now be visible
- Correct interpretation

Teaching Point

- **Always verify filter settings before interpretation**
- Settings must be checked first
- Cannot interpret without knowing settings

- Settings can create false appearances
- Essential step in interpretation

ABRET Application

- Given normal-appearing EEG in encephalopathy → check LFF
- Given missed epileptiform activity → check HFF
- Given interpretation question → verify settings first
- Must know standard settings and effects

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9. Exam Readiness Checklist

Use this checklist to verify your understanding:

- [ ] Can explain LFF effects (attenuates delta, masks slowing)
- [ ] Can explain HFF effects (attenuates spikes, smooths sharp waves)
- [ ] Can adjust sensitivity appropriately (7.5–10 μV/mm routine)
- [ ] Can identify filter-induced distortion (false-normal, false-abnormal)
- [ ] Understand that filters modify frequencies displayed
- [ ] Know that sensitivity controls amplitude scaling
- [ ] Recognize that improper settings distort interpretation
- [ ] Know that technical settings affect appearance, not brain activity
- [ ] Can identify common ABRET exam traps
- [ ] Know standard settings (LFF 0.1–0.3 Hz, HFF 35–70 Hz, Sensitivity 7.5–10 μV/mm)
- [ ] Understand time constant concept
- [ ] Can predict EEG changes with setting alterations

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10. Internal Cross-Links

Patterns

- **Diffuse Slowing:** How LFF affects slowing visibility
- **Epileptiform Discharges:** How HFF affects spike visibility
- **Artifacts:** How filters affect artifact appearance

Workflow

- **Timebase & Sampling:** Other technical settings
- **Amplifiers & Sensitivity:** Detailed sensitivity information
- **Filters & Time Constants:** Detailed filter information

Cases

- **Technical distortion cases:** Cases involving filter/sensitivity issues
- **Missed findings cases:** Cases where settings hid findings

Quizzes

- **Filter & sensitivity MCQs:** Questions on filter and sensitivity effects
- **Setting prediction questions:** Questions on predicting changes
- **Distortion identification questions:** Questions on identifying technical distortion

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Study Tips

1. **Memorize standard settings:** LFF 0.1–0.3 Hz, HFF 35–70 Hz, Sensitivity 7.5–10 µV/mm
2. **Learn filter effects:** High LFF masks slowing, low HFF masks spikes
3. **Understand sensitivity:** Lower number = higher sensitivity
4. **Know the principle:** Settings affect appearance, not brain activity
5. **Remember the traps:** Confusing sensitivity with amplitude, attributing filter effects to pathology
6. **Know the relationship:** Time constant relates to LFF
7. **ABRET focus:** Expect questions on filter effects, sensitivity relationship, and setting verification

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End of Study Guide

For additional practice, complete quiz questions tagged: lff, hff, sensitivity, time-constant, distortion