

Bayesian Prior Selection Guidance for Polygraph Examiners

Professional Guidance for the Polygraph Evidence Evaluator

The Centre for Forensic Neuroscience Credibility Systems

Purpose

This document provides guidance on selecting, documenting, and defending prior probabilities when using the Polygraph Evidence Evaluator.

The prior probability is often the most influential assumption within any Bayesian analysis. A carefully selected and well-documented prior can improve transparency and consistency. A poorly justified prior can undermine the credibility of the entire analysis.

This guidance is intended to support professional judgement rather than replace it.

What is a Prior Probability?

A prior probability represents the examiner's assessment of the likelihood that a proposition is true before considering the polygraph result.

For example:

Proposition:

"The examinee is withholding relevant information concerning the issue under investigation."

The prior probability reflects the examiner's assessment before considering the physiological evidence generated during the examination.

Why Priors Matter

Consider the same ESS result producing a Bayes Factor of 10.

Scenario A

Prior Probability = 10%

Posterior Probability = 52.6%

Scenario B

Prior Probability = 50%

Posterior Probability = 90.9%

Scenario C

Prior Probability = 75%

Posterior Probability = 96.8%

The polygraph evidence is identical in all three examples.

Only the prior changes.

Consequently, prior selection must be transparent and defensible.

General Principles

Principle 1: Avoid Hidden Priors

Every examiner has a prior belief.

The choice is not between:

- having a prior
- not having a prior

The choice is between:

- making the prior explicit
- leaving the prior implicit

The Polygraph Evidence Evaluator is designed to make assumptions visible.

Principle 2: Use the Least Assertive Prior Justified by the Evidence

When uncertainty exists, a more conservative prior is generally preferable to an aggressive prior.

Examiners should avoid:

- artificially high priors
 - artificially low priors
 - priors chosen to support a desired conclusion
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Principle 3: Separate Facts from Interpretation

Facts should be documented separately from conclusions.

Example:

Fact

The examinee's account changed three times.

Interpretation

The changing account may indicate concealment.

The prior should be based on documented facts and the reasoning process should be explained.

Recommended Prior Categories

Category 1: Neutral Prior

Recommended Value

50%

Use When

- Information is limited.
- Evidence is contradictory.
- The examiner wishes to avoid pre-test weighting.

Advantages

- Simple

- Transparent
- Easily explained

Limitations

- May ignore meaningful contextual information.
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Category 2: Base-Rate Prior

Use When

Published prevalence data exist.

Examples:

- Sexual recidivism studies
- PCSOT disclosure studies
- Substance abuse monitoring
- Employment screening programmes

Example

Research indicates that 35% of examinees in a particular population fail to disclose prohibited conduct.

Prior Probability = 35%

Advantages

- Empirically grounded

Limitations

- Population data may not reflect the individual case.
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Category 3: Case-Fact Prior

Use When

Specific case information exists.

Examples:

- Contradictory statements
- Documentary evidence
- Independent witness evidence

- Digital evidence
- Investigative findings

Example

An examinee denies downloading prohibited material.

Independent forensic examination identifies extensive searches and downloads.

A higher prior may be justified.

Advantages

- Tailored to the case

Limitations

- Requires careful documentation
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Category 4: Structured Assessment Prior

Use When

A formal assessment tool is available.

Examples:

- Credibility Systems screening tools
- Disclosure reliability assessments
- Relationship trust assessments
- Risk assessment instruments

Advantages

- Consistent methodology
- Reduced examiner subjectivity

Limitations

- Dependent on instrument validity
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Category 5: Examiner Judgement Prior

Use When

No suitable alternative exists.

Requirements

The examiner should explicitly document:

- observations considered
- reasoning process
- uncertainty

Advantages

- Flexible

Limitations

- Most vulnerable to criticism
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Suggested Prior Ranges

These are guidance ranges only.

Minimal Pre-Test Concern

10–30%

Examples:

- Limited corroboration
 - Weak allegations
 - Sparse evidence
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Neutral Position

40–60%

Examples:

- Conflicting evidence

- Uncertain case circumstances
 - Routine screening
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Moderate Concern

60–80%

Examples:

- Significant inconsistencies
 - Corroborative evidence
 - Partial admissions
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High Concern

80–95%

Examples:

- Strong corroboration
 - Extensive independent evidence
 - Multiple admissions
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Priors That Require Special Justification

The following should trigger enhanced documentation.

Prior Below 5%

Reason:

Extremely low priors can make it difficult for even strong evidence to meaningfully alter conclusions.

Prior Above 95%

Reason:

Extremely high priors can render the polygraph result largely irrelevant.

Recommended Documentation

When selecting a prior below 5% or above 95%, explain:

- why alternative priors were rejected
 - why the chosen value is reasonable
 - how uncertainty was considered
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Prior Selection Checklist

Before finalising a prior, ask:

Evidence

- What objective facts support this prior?
- What facts contradict it?

Reliability

- How reliable are the information sources?
- Are there alternative explanations?

Bias

- Am I influenced by expectations?
- Am I influenced by previous examinations?
- Am I influenced by external pressures?

Transparency

- Could another examiner understand how I arrived at this value?
-

Sensitivity Analysis

Every report should examine alternative priors.

Example:

Primary Prior = 60%

Alternative Priors:

- 40%

- 50%
- 70%
- 80%

If the posterior conclusion changes dramatically, confidence in the model should be reduced.

If conclusions remain relatively stable, confidence may increase.

Defensible Reporting Language

Preferred

"The prior probability was selected following review of the available case information and documented assumptions."

"The selected prior was subjected to sensitivity analysis using alternative values."

"The posterior probability is conditional upon the prior probability and evidential weight assumptions recorded within this report."

Avoid

"I knew the examinee was lying."

"The prior reflects my experience."

"The prior was obvious."

"The prior was selected because the allegation seemed credible."

Special Considerations for PCSOT Examinations

For PCSOT examinations, priors should not be based solely upon:

- offence type
- criminal history
- treatment status

Relevant considerations may include:

- disclosure history
- supervision history
- treatment participation

- behavioural indicators
 - independent corroboration
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Special Considerations for Relationship and Disclosure Examinations

Relationship and disclosure examinations frequently involve emotionally charged allegations.

Examiners should be cautious of:

- confirmation bias
- relationship pressure
- coercion
- selective evidence presentation

Neutral or near-neutral priors are often appropriate unless strong independent evidence exists.

Final Recommendation

Where no strong empirical basis exists for a different value, a prior probability of 50% remains the most transparent and defensible starting point.

The burden of justification increases as the prior moves further from neutrality.

The examiner should always be capable of explaining:

1. Why this prior was selected.
2. What information was considered.
3. What alternative priors were considered.
4. How the conclusion changes under sensitivity analysis.

A Bayesian analysis is only as credible as the assumptions upon which it is built.