

The Impact of Disguise on Eyewitness Identification Decisions, Accuracy, and Confidence: An Experimental Study Using Brain Electrical Oscillation Signature Profiling (BEOS)

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ABSTRACT

Eyewitness identification is central to criminal investigations, yet it is vulnerable to error, particularly when perpetrators use disguises. This experimental study examined how different types and degrees of disguise and lineup procedures influence eyewitness identification decisions, accuracy, and confidence, and how these relate to experiential knowledge as indexed by Brain Electrical Oscillation Signature Profiling (BEOS). Thirty adult participants of African descent viewed a mock crime and then completed multiple lineup tasks under three disguise conditions (no disguise, bleached skin, white bucket hat) and two lineup types (simultaneous, sequential). BEOS was used to record electrophysiological signatures during presentation of neutral, autobiographical (control), and crime-related probes, focusing on Primary Processing (PP), Inattention (I), Encoding (EN), Emotional Response (ER), Activation–Suppression (AS), and Experiential Knowledge (EK). Behaviourally, increasing disguise coverage reduced identification accuracy, with simultaneous lineups producing more correct identifications and sequential lineups more correct rejections.

Confidence generally decreased as disguise increased, indicating some metacognitive sensitivity to encoding quality, though choice rates did not decline as steeply as accuracy. BEOS data showed robust EK responses for autobiographical and critical crime probes, and complex patterns of PP, EN, I, and AS across scenarios. ANOVA analyses revealed significant relationships between PP and Inattention and between EN and EK in key scenarios. The findings suggest that disguise impairs both accuracy and confidence, that witnesses are partially aware of this impairment, and that BEOS can capture experiential knowledge associated with observed events. Implications for lineup procedures, the interpretation of eyewitness confidence, and the integration of neurocognitive evidence in forensic practice are discussed.

Keywords: eyewitness identification, disguise, confidence, BEOS, experiential knowledge, lineups, forensic psychology.

INTRODUCTION

Eyewitness identification remains a cornerstone of criminal investigation and adjudication. Nonetheless, decades of research and numerous DNA exonerations demonstrate that eyewitness misidentification is a leading contributor to wrongful convictions. Disguise represents a particularly potent source of error: by altering or occluding facial features, it can impede encoding, distort later recognition, and undermine both the accuracy and the perceived reliability of eyewitness testimony.

Prior work has shown that disguises that obscure specific features (e.g., hats, glasses) and those that distort the global facial configuration (e.g., stockings) can each reduce identification performance, albeit through potentially different mechanisms. Hair and eye regions appear especially critical: manipulating hair cues or glasses between encoding and test often lowers recognition accuracy. Everyday items such as hats and sunglasses may function as effective disguises even when witnesses fail to treat them as such, potentially due to attenuated meta-cognitive awareness of their impact on recognition.

Parallel to this, courts and policy-makers have increasingly expressed skepticism about the reliability of eyewitness confidence as an indicator of accuracy. Jury instructions in several jurisdictions now explicitly caution that confidence is generally an unreliable predictor of correctness, often without differentiating between initial, uncontaminated confidence and later, post-feedback expressions, or between pristine and flawed identification procedures. Experimental work, however, suggests that under controlled, bias-free conditions, high initial confidence can correlate strongly with accuracy, whereas under contaminated conditions this relationship degrades.

The present study extends this literature by examining:

- a) How types and degrees of disguise affect eyewitness line-up decisions, accuracy, and confidence.
- b) How lineup format (simultaneous vs. sequential) interacts with disguise.
- c) How cognitive and neural indices of experiential knowledge, as measured by Brain Electrical Oscillation Signature Profiling (BEOS), relate to eyewitness performance and subjective confidence.

BEOS is a non-invasive electrophysiological method designed to detect experiential knowledge—whether a person has personally participated in or directly experienced the events described in a probe. It distinguishes primary (first-hand) from secondary (indirect/hearsay) encoding, offering a neurocognitive complement to behavioural measures of identification and self-reported confidence.

This study used BEOS to examine the brain signatures underlying recognition of crime-related events, alongside traditional lineup outcomes, in order to understand how disguise modulates both explicit decisions and implicit experiential traces.

METHOD

Participants

Thirty participants (13 females, 17 males) were recruited from the National Forensic Science University (NFSU), Gandhinagar, India. All were: Aged above 30 years of African descent

Participants were randomly sampled, with 10 in each age band: 30–35, 35–40, and 40–45 years. All provided informed consent for participation and BEOS recording.

Design

The study used an experimental mixed design with:

- Between/within-subject manipulations of disguise:
- No disguise
- Bleached skin (temporal whitening lotion)
- White bucket hat

Lineup type:

-Simultaneous

-Sequential

-Target presence:

-Target-present

-Target-absent



Participants viewed a mock crime video depicting a staged offence (including restaurant scenes, suspicious men, a shooting, and police arrival). Afterwards, they viewed lineups containing the suspect in different disguise conditions and were asked to identify the perpetrator.

Two main behavioural trials were used:

Trial 1: Target present in the first lineup, then absent in a subsequent lineup.

Trial 2: Target disguised using a toque/hat and temporary skin bleaching; combinations of presence/absence and disguise were repeated so that each participant experienced all disguise levels across lineups. Lineups were constructed with one suspect and fillers, and both simultaneous and sequential presentation methods were used repeatedly across conditions.

Procedure

Mock crime exposure:

Participants watched a video of a fictitious crime involving an African-descended perpetrator, with multiple related scenes (inside a restaurant, outside the restaurant, suspicious individuals, the shooting, and police arrival).

Lineup tasks

After the video:

Participants viewed either simultaneous or sequential lineups containing the suspect in various disguise conditions (no disguise, bleached skin, white bucket hat).

For each lineup, they were instructed to decide whether the perpetrator was present and, if so, to identify that individual.

Participants also provided subjective confidence ratings (e.g., via verbal or written reports) regarding their decisions.

Written statements

Participants wrote brief narratives describing:

- a) What they saw during the staged crime,
- b) Who they identified, including under disguise conditions.

These statements were later used to construct individualized BEOS probes.

BEOS recording

BEOS was conducted after the behavioural tasks:

Participants were prepared with a 31-electrode EEG cap covering prefrontal, parietal, occipital, and temporal regions.

The Visual and Auditory Stimulus Programming (VASP) system was used to present verbal probes in auditory form, scenario by scenario.

Probes were of three main types:

- Neutral probes (e.g., “the sand is brown”, “the sun is blazing hot”, “roses are red”)
- Control/autobiographical probes confirming personal data (e.g., age, nationality)



- Crime-scenario probes (restaurant events, outside restaurant, suspicious men, shooting, police arrival, eyewitness identification decisions)

Participants received no questions and gave no responses during recording; they were instructed to:

- Stay calm with eyes closed
- Remain alert and listen
- Inform the examiner only if a pause was needed
- A baseline EEG (eyes closed, ~3 minutes) was recorded, followed by presentation of probe sets while EEG was continuously recorded.

BEOS analysis focused on six signatures:

- Primary Processing (PP)
- Inattention (I)
- Encoding (EN)
- Emotional Response (ER)
- Activation–Suppression (AS)
- Experiential Knowledge (EK)

These were quantified for each scenario and probe, and analysed using SPSS.

Data Analysis

Descriptive statistics were used for:

- Demographic variables
- Accuracy and confidence ratings
- BEOS signature distributions (means, SDs, ranges)
- Inferential statistics:

Pearson correlations for selected scenarios (e.g., between PP, I, EN, EK)

ANOVAs for:

Relationships between PP and I (Scenario 7 – shooting)

Relationships between EN and EK (Scenario 7 – shooting)

Effects of disguise type, degree, and lineup format on accuracy and confidence (summarised in the Discussion, as the raw behavioural tables are not reproduced)

Multivariate analyses:

Used conceptually (and partly reported) to explore relationships between BEOS signatures (especially EK) and behavioural measures (accuracy, confidence). Ethical procedures included informed consent, explanation of purpose and procedures, participants' right to withdraw, and information on data confidentiality.

Results

BEOS Signatures: Neutral and Control Probes

Neutral probes (Scenario 1)

- PP and I showed variability (PP SD $\approx$ 2.58; I SD $\approx$ 4.37).
- EK was absent (constant zero), as expected.

- A significant negative correlation between PP and I ($r \approx -.89$, $p < .05$) indicated that greater primary processing was associated with lower inattention.
- No experiential knowledge emerged for neutral content.

Control/autobiographical probes (Scenario 2)

- EK showed substantial variation ($SD \approx 2.88$), indicating remembrance of personal facts.
- PP and EN had relatively higher SDs; ER remained zero.
- Means for PP and I were relatively high (around 5–9), showing active processing and moderate attentional engagement.
- This pattern validated BEOS's sensitivity to true autobiographical information.
- BEOS Signatures: Crime-Related Scenarios

Across scenarios depicting restaurant events, outside the restaurant, suspicious men, the shooting, police arrival, and eyewitness identification:

Primary Processing (PP) was generally elevated on critical action probes (e.g., asking for the bill, food arriving, entering the restaurant, suspicious men's appearance, the shooting).

Inattention (I) varied by probe and scenario; some probes (e.g., routine or less salient statements) elicited high inattention scores.

Encoding (EN) was high on many central-event probes (e.g., "our food came and we ate it", "the person was 1.65 meters tall"), suggesting consolidation of key crime details.

Emotional Response (ER) was often zero or negligible, indicating limited explicit emotional reactivity within the recorded window.

Activation–Suppression (AS) appeared on some probes, indicating suppression or inhibition of recall (e.g., participants not making effort to recall events).

Experiential Knowledge (EK) was present and sometimes strong for:

- a) Entering the restaurant
- b) Viewing suspicious men
- c) Witnessing the shooting
- d) Observing police arrival
- e) Identifying suspects in the eyewitness phase

For example:

In the suspicious men scenario (Scenario 6), EK $SD \approx 1.00$ with a positive skew (≈ 1.05), indicating clustered but asymmetric EK responses. Inattention $SD \approx 1.81$ suggested considerable variance in attention.

In the shooting scenario (Scenario 7), single-sample statistics showed relatively low mean EK (~ 1.06 , $SD \approx 1.07$) but high EN variability ($SD \approx 2.82$), suggesting widespread encoding but selective strong experiential traces.

ANOVA relating PP (dependent) and Inattention (predictor) in Scenario 7 showed:

Regression sum of squares = 27.793; residual = 24.484; $df_{\text{regression}} = 1$, $df_{\text{residual}} = 16$.

Although the F statistic (≈ 1.62) was not statistically significant at conventional levels ($p \approx .22$), the pattern indicated that variations in attention partially accounted for PP.



ANOVA relating EK (dependent) and EN (predictor) in Scenario 7 similarly showed comparable sums of squares (≈ 15.334 regression, 14.611 residual), indicating that encoding activity is meaningfully associated with experiential knowledge, though again not overwhelmingly so in this sample.

Eyewitness Identification Scenario (Scenario 9)

Probes targeting the eyewitness's own identification process ("came to see suspects", "looked like suspect number 4 with white bucket hat", "the four lined up", "the two were wearing black hats") showed:

High EK values on key probes, with: Up to 20 participants showing EK on "came to see suspects". EK also elevated for probes about specific disguised suspects.

Inattention peaked for some probes (e.g., around 7.5 mean for certain items), suggesting episodic lapses of attention during some aspects of the recounting.

Encoding, PP, and AS all varied systematically, indicating that participants actively processed, encoded, and sometimes suppressed or inhibited recall of identification-relevant details.

Behavioural Outcomes: Accuracy, Lineup Type, and Disguise

Although the full numeric behavioural data are not reproduced, the Discussion summarises:

Accuracy decreased as degree of disguise increased (more of the face covered or more structural distortion). Simultaneous lineups yielded more correct identifications of the target.

Sequential lineups yielded more correct rejections when the target was absent.

Disguise conditions with 2/3 or full facial coverage produced:

Similar percentages of target-present selections, correct rejections, and identifications across conditions, indicating severe disruption of both accuracy and trust.

Confidence Patterns

- Confidence generally declined with increased disguise:
- Witnesses were less sure when more of the face was hidden or the skin colour was altered.
- Participants were sensitive to encoding conditions:
- They anticipated that eye-covering or skin whitening would make identification harder.
- Confidence dropped accordingly, particularly for identification choices.
- For accurate rejections, confidence patterns were more complex:
- Skin whitening sometimes produced a larger drop in confidence than wearing a white bucket hat alone.
- Hat-only conditions decreased confidence primarily when compared to no disguise, suggesting a threshold or non-linear effect.

Overall, choice rates (the decision to select someone) decreased much less sharply than accuracy as disguise increased, indicating that witnesses did not fully adjust their decision thresholds to match the degraded quality of facial information.

DISCUSSION

This study investigated how disguise affects eyewitness identification decisions, accuracy, and confidence, while also examining underlying experiential knowledge using BEOS. Several core conclusions emerge.

Disguise Reduces Identification Accuracy

As predicted, increasing facial coverage and distortion reduced identification accuracy. Disguises that altered the overall facial configuration (e.g., covering two-thirds or the entire face) appeared at least as detrimental as those primarily masking individual features such as hair or eyes. These findings align with prior work suggesting that both global and feature-based cues are crucial for face recognition, and that altering hair, glasses, or other salient features between encoding and test can impair performance.

Lineup Format Modulates Performance

Consistent with previous research, simultaneous lineups produced more correct identifications, whereas sequential lineups produced more correct rejections. This pattern underscores the trade-off between catching the guilty and exonerating the innocent and highlights the importance of matching lineup format to investigative priorities while maintaining procedural safeguards (e.g., one suspect per lineup, unbiased fillers, double-blind administration).

Confidence Reflects—but Imperfectly—Encoding Quality

Confidence generally decreased with greater disguise, indicating that witnesses were at least partially aware that disguise impeded their recognition ability. This suggests that confidence, when measured immediately and under controlled, uncontaminated conditions, can contain meaningful information about the quality of memory and the likelihood of correctness, even in challenging contexts like disguise.

However, confidence did not fully track the extent of degradation in accuracy. Choice rates decreased more slowly than accuracy as concealment increased, implying that witnesses did not always appropriately adjust their willingness to choose based on reduced facial information. Social factors and norms about “needing to decide” may also influence selection tendencies, even when witnesses sense that their memory is weak.

BEOS Reveals Experiential Knowledge and Cognitive Dynamics

The BEOS data demonstrate that:

- EK signatures reliably appeared for:
- Personal autobiographical details (control probes)
- Critical crime-related events (e.g., entering the restaurant, suspicious men, shooting, police arrival, suspect identification)
- Neutral probes elicited no EK, as expected.
- Patterns of PP, EN, I, and AS varied systematically across scenarios, highlighting:
- Where participants concentrated cognitive resources (PP, EN)
- Where attention lapsed (I)
- Where recall was suppressed or inhibited (AS)

In key scenarios (e.g., the shooting), ANOVAs linking PP with Inattention and EK with Encoding, though not always statistically strong in this modest sample, indicated that:

Greater encoding activity is associated with higher experiential knowledge.

Attention modulates the depth of primary processing of crime-related details.

Thus, BEOS provides independent neurocognitive support for the idea that participants genuinely encoded and remembered key aspects of the crime, while also revealing internal variability in attention and suppression that behavioural measures alone cannot capture.

Legal and Forensic Implications

Disguise must be explicitly accounted for when evaluating eyewitness identifications. Heavier coverage or structural facial changes significantly undermine accuracy and should lower reliance on such identifications in isolation.

Witness confidence:

Cannot be taken at face value in all cases, especially under contaminated or biased conditions.

But under pristine procedures and initial expression, it can be informative, especially when downwardly adjusted in response to disguise.

Jurors and practitioners should be educated to differentiate:

- Initial vs. later confidence
- Procedures that protect vs. degrade memory

BEOS and experiential knowledge:

BEOS may offer a supplementary tool for assessing whether a witness (or suspect) has actually experienced specific crime-related events.

Its sensitivity to EK vs. non-experiential information could, in principle, help evaluate the authenticity of claims or the depth of encoding, though legal and ethical considerations are substantial.

Limitations

The design did not fully isolate all four hypothesised mechanisms of disguise (e.g., information availability, perceived threat, attentional distraction, meta-cognitions). The present data strongly support reduced information availability as a main factor and suggest meta-cognitive influence, but do not experimentally disentangle them.

Only two main disguise types (skin bleaching, hat) and their combinations were examined. Results may not generalise to other disguises (e.g., masks, wigs, stocking over the face) or viewing conditions (e.g., very low light, high stress).

The repeated-measures design and multiple sequential scenarios differ from real-world situations where witnesses typically experience a single incident and one or few identification procedures.

Social pressures present in real police and courtroom settings were absent here; in real life, these pressures may further distort both choices and expressed confidence.

Emotional response was often near zero in BEOS data, potentially reflecting the laboratory nature of the mock crime.

Future Directions

Future research should:

Experimentally separate mechanisms (information availability, attention, perceived threat, meta-cognition) by manipulating them independently (e.g., via eye-tracking, galvanic skin response). Study a broader range of disguises and environmental conditions, including multi-perpetrator incidents and witness involvement under stress.

Explore instructions that encourage witnesses to explicitly consider quality of exposure and clarity of recollection before deciding, to see if this reduces errors in high-disguise conditions. Further validate the



confidence–accuracy relationship under systematically varied procedural quality and disguise levels, with larger samples. Examine the legal and ethical integration of BEOS evidence into investigative practice and courtroom evaluation, ensuring safeguards against misuse.

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