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# Finding Private Ferguson: A case study of person identification from World War II images

**Markus Bindemann**[1]

## Abstract

Person identification from historical photographs presents substantial forensic challenges due to image degradation, uncontrolled capture conditions, and limited availability of suitable comparison material. This study presents a case investigation concerning the potential identification of a British soldier depicted in a large group photograph taken in 1944. Several analytical approaches were applied, including facial image analysis conducted by forensic examiners, an automatic face recognition system (AFRS), and contextual evaluation of relevant historical information. We show that the group photograph is of insufficient quality for facial image comparison by forensic examiners, but the AFRS consistently identified two potential targets from this photograph against a set of four comparison images. Of these, one soldier from the group photograph was matched by the AFRS above threshold against two of the comparison images, but a subsequent examination of contextual information revealed these identifications to be false positives. This case highlights the limits of face recognition from historical material and the value of combining AFRS output with contextual evidence such as military rank, photograph position, and leave records. In doing so, this single-case study demonstrates the important complementary roles of different information sources when addressing complex person identification problems in applied contexts.

## Keywords

face perception, person identification, automatic face recognition, cognition

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## Background

The identification of individuals from historical wartime images is important for many reasons. It can contribute to investigations into war crimes, help locate missing persons, and improve our understanding of past events. Such identifications also carry personal significance for the families of those involved. Knowing where someone was, and when, can provide closure, comfort, or simply satisfy curiosity. This single-case study presents an attempt to identify one such individual using forensic facial examiners and automatic face recognition.

This story begins in June 1944 in Normandy, France. Between the town of Caen and the port of Ouistreham, the Bénouville Bridge once crossed the Caen Canal. During World War II, this bridge was strategically important for controlling access to the coastline. In the early hours of 6 June 1944, as part of the Allied invasion of Normandy, a force of less than 200 men from the 6th British Airborne Division arrived in Horsa gliders to capture the bridge. Landing silently nearby shortly after midnight, the troops surprised the German forces guarding it and secured the bridge quickly. Their success played a crucial role in preventing German counterattacks against the D-Day landings. The bridge was later renamed Pegasus Bridge after the winged horse emblem worn by British airborne forces. Among the units involved in the Normandy operation was the 225 Parachute Field Ambulance, a Royal Army Medical Corps unit attached to the 5th Parachute Brigade. Its soldiers were parachute-trained medics who landed in Normandy shortly after midnight on 6 June 1944 to support the fighting troops. Their task was to establish a Main Dressing Station at a château at Le Bas de Ranville, where casualties from the battle around Pegasus Bridge would be treated.

Today, the original Pegasus Bridge is preserved at the Pegasus Museum in Ranville, which commemorates the events of that night. Among the exhibits is a group photograph of the 225 Parachute Field Ambulance taken in January 1944, 5 months before the Normandy landings. Reproduced in Figure 1, the photograph shows 148 soldiers arranged in five rows. One of the men in this photograph is David Ferguson, born at the Maternity Hospital in Glasgow, Lanarkshire, on Rotten Row on 13 October 1919. He was mustered into the army three days after his 20th birthday, on 16 October 1939. David was part of my own family: he was the father of my father-in-law, William Ferguson, the grandfather of my wife, Heather Ferguson, and the great-grandfather of our children. Members of David's family have visited the Pegasus Museum and examined this photograph in the hope of identifying him among the depicted soldiers, but without success.

## Human Face Perception

The challenge of identifying people from photographs, and its relevance to practical settings, has been studied extensively in Psychology (Bindemann, 2021). Consequently, some important aspects of face identification are now well understood. It has been established, for example, that faces *familiar* to an observer – such as those of friends and family – can be recognised with speed and accuracy (Bruce, 1986; Bruce et al., 1998; Bruce & Valentine, 1985). This is observed even under conditions that should make this task difficult, for example, from small and degraded face images (Bruce et al., 2001; Brunas et al., 1990; Burton et al., 1999) or when identification is required from old recordings, such as yearbook photos (Bahrick et al., 1975; Bruck et al., 1991). The group photograph from 1944 confounds this situation. *Despite* familiarity, members of David's family cannot identify him from the image.

In light of this, alternative routes to identification must be explored. In the police, forensic and security domains, the identification of *unfamiliar* faces, of people who are not known to an observer, is often required. An example of such a task is face matching, in which images must be compared to determine whether these depict the same person or different people. These face identifications can be prone to error even under highly optimised conditions, such as when only two photos are compared




**Figure 1.** The group photo of 225 Parachute Field Ambulance, recorded in January 1944. This photo is displayed in the Pegasus Museum in the commune of Ranville, Normandy, in France.

(Alenezi & Bindemann, 2013; Bindemann et al., 2012; Burton et al., 2010). Moreover, when many images must be compared, difficulties in face identification disproportionately reflect a problem in *telling people together* – that is, in realising when two or more images show the same person – than in *telling people apart* (Jenkins et al., 2011). The group photograph in Figure 1 introduces further factors that make this task difficult. For example, this photograph shows a young David, whose appearance will have changed subsequently through ageing. There are a great many identities (148) to search through, who are of similar appearance, due to wearing standard uniform, similar hairstyle and facial expression. Image quality is also suboptimal as regions of the image are over-exposed or damaged.

One group of professionals that specialises in face matching under similarly challenging conditions are forensic facial examiners. These experts reside within the police, forensic service providers or other government organisations and perform identifications in criminal investigations and judicial proceedings. They receive years of advanced training in facial identification – or *facial image comparison* – and follow strict protocols to perform meticulous forensic examinations to determine whether two or more face images depict the same person (for a review, see Moreton, 2021). Examiner casework often involves images that are sub-optimal. Therefore, in a first step, examiners typically note down parameters and conditions of the to-be-analysed image files that might impact the comparison. This includes aspects such as the pose and expression of the subject in the image, exposure settings and focal distance, and the light source and intensity of the environment in which an image was acquired. The examiners will also study the level of facial detail that is present in the image and how well resolved they are. For example, this includes whether sub-components of facial features are visible (e.g., the eyelids of the eyes) and fine detail such as moles or blemishes. Only once an examiner has completed this initial analysis of the questioned image will they be able to view the reference images that are used for comparison.

Two senior facial examiners from the London Police Service were approached to help with the identification of David by applying standard procedures. Both examiners had more than six years' experience of making facial comparisons in police settings. The examiners were given the large group photo and three comparison images of David, from memorabilia held by the family. These comparison images are depicted in Figure 2. The timepoint at which these images were recorded is unknown, but the portraits on the left and in the centre are believed to pre-date World War II, whereas the image on the right was taken after David was enlisted and must therefore be dated between 1939 and 1945. Both examiners assessed these materials independently and deemed the faces of the large group photo to be of insufficient quality for forensic identity comparisons based on their work protocols, due to the lack of featural detail. Therefore, considering that familiar face recognition fails in this instance, and the identification challenge cannot be resolved through facial



**Figure 2.** Comparison photos of David Ferguson.

image comparison by forensic facial examiners, a different approach is needed. One possibility is to attempt identification of David with an automatic face recognition system.

## Automatic Face Recognition Systems (AFRSs)

In recent years, AFRSs have improved rapidly and now outperform human observers on tests of face matching (O'Toole & Castillo, 2021; Parde et al., 2023; Phillips et al., 2018). In this case, the *Amazon Rekognition* system (https://aws.amazon.com/rekognition/) is employed, as this is highly proficient at face matching and widely accessible. The Kent Face Matching Test can provide a background illustration of the system's capability (Fysh & Bindemann, 2018a). This test is comprised of face pairings combining photos from student identity cards and a passport-style portrait taken a few months later. Some examples of these face pairings are illustrated in Figure 3. The reader is invited to inspect these to decide which depict the same person (i.e., are an identity match) and which comprise of two different people (a non-match).

Scientific experiments in Psychology have shown repeatedly that tests of this nature are remarkably difficult (Burton et al., 2010; Stantic et al., 2022; White et al., 2022). For example, the short version of the KFMT comprises of 40 face pairs (20 matches and 20 non-matches). If an observer responded randomly in this test, without paying any attention to the faces, they would be expected to register an accuracy of 50%. The average accuracy of human participants who are genuinely trying to complete this test is 66%, and ranges from around 40% for the worst to 80% for the best observers in the normative dataset published with this test (Fysh & Bindemann, 2018a). In contrast, the Amazon Rekognition AFRS resolves these 40 face pairings with perfect accuracy (i.e., 100%). Moreover, the mean similarity ratings provided by the AFRS for the KFMT face pairs are 99.7 for matches (range = 98.3–99.9) to 6.7 for non-matches (range = 0.1–37.6), demonstrating clear separation in how these same- and different-identity pairings are categorised. This performance illustrates that the AFRS performs well on modern benchmark face pairs, such as the passport-style images employed in the KFMT. The question arises whether this AFRS can also successfully match identities in WWII imagery such as the 1944 group photograph of the 225 Parachute Field Ambulance containing David Ferguson.

In all image comparisons reported below, the AFRS was employed with its default settings (version rekognition-console-v4-prod-iad) and this work was conducted in July 2026. For all identification attempts, faces were uploaded individually on their immediate image background, so no



**Figure 3.** Example face pairings from the Kent Face Matching Test, depicting identity matches and non-matches. The reader is invited to decide which is which.[3]

cropping or image enhancements were applied. All faces were successfully located within the images by the AFRS's automatic detection system, and no identities were excluded from processing (e.g., due to partial occlusion or blur). The AFRS provides similarity ratings for each facial comparison on a scale from 0 to 100, with scores above 86 indicating an identity match when default settings are employed.

To apply the AFRS to the large group photo, the face portraits in Figure 2 were applied as comparison images for each of the depicted soldiers. First, to validate whether the AFRS can identify David *at all*, the accuracy with which these three individual images are matched against each other was examined. All three images were identified as matches to each other, with the AFRS providing near-ceiling similarity scores of 99.9 for all comparisons.[1]

It was then examined whether these images could be matched by the AFRS against a lower-quality image that is more similar to the large group photo of the Field Ambulance. For this purpose, a smaller 'postcard' group photo was utilised, from the possession of David's family. This picture depicts 47 men and is reproduced in Figure 4. In this photograph, David's location was known to his family – he is the fourth person from the right in the third row. David's face image from this group photo is matched successfully by the AFRS against each of the three comparison images, with high similarity ratings of 93.1, 97.8 and 95.8. Moreover, when the remaining men in this group photo are compared against the three portraits of David, all obtain substantially lower similarity ratings. These ratings are illustrated in Figure 5 and indicate that David was identified unambiguously from this group photo by the AFRS.

Several insights emerge from this line of inquiry so far. The AFRS's superiority over human observers has been demonstrated with a challenging face-matching test. However, while the KFMT comprises of contemporary face photographs, the AFRS also matches older portraits of David against each other with high certainty. Furthermore, it can match these portraits successfully against David's face on a small postcard group photo from World War II *and* distinguishes him



**Figure 4.** A postcard group photo that is in the possession of David's family, depicting 47 soldiers, including David in the third row.

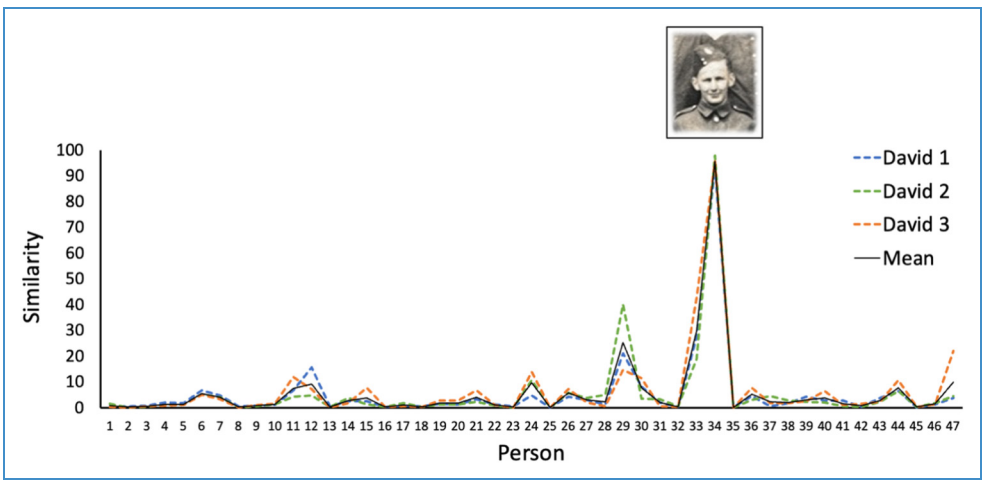



**Figure 5.** Automatic face recognition system (AFRS) similarity ratings for the three comparison portraits of David with every person in the small group photo. The peak is David's known match in the group photo.

clearly from all other men depicted in this image. Thus, the suitability of this method to achieve the primary objective has been validated – to identify David from the large group photo of the Field Ambulance in Figure 1.

We now attempt to identify David from this large group photo using the AFRS. This group photo presents a number of challenges that are likely to make this identification more difficult. There are more than three times as many men in this image than the group photo in Figure 4. The lighting quality is also variable, as the men on the left of the image are overexposed compared to the men

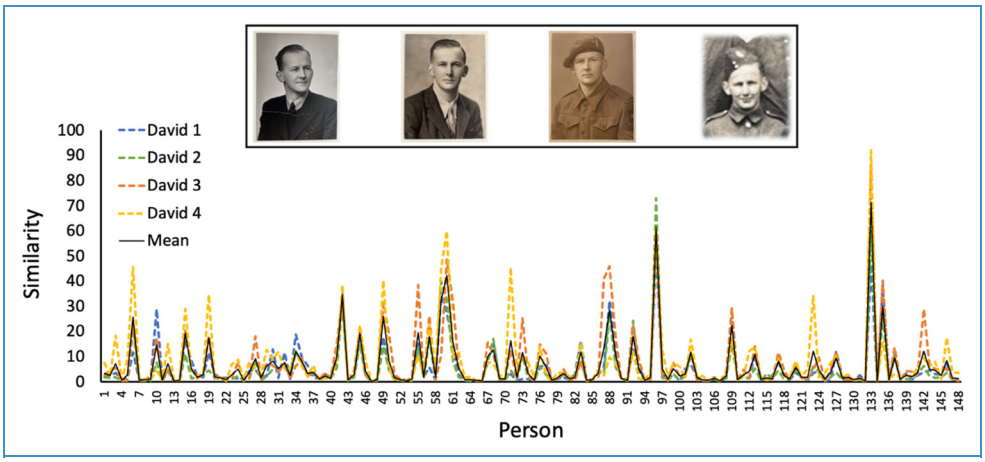



**Figure 6.** Automatic face recognition system (AFRS) similarity ratings for the four comparison images of David with every person in the large group photo.

on the right, reducing facial contrast and texture information. The image also contains creases that obscure some of the faces.

To determine if David is present in Figure 1, his three portraits were compared against every single face in this large group photo with the AFRS. In addition, a fourth comparison image was utilised, consisting of David's face from the smaller postcard group photo in Figure 4. This provides a valid comparison as it was identified against the three portraits. Moreover, this image is more similar in quality and pose to the faces in the large group photo than the other portraits and might therefore provide a particularly suitable comparison. The data from this analysis is provided in Figure 6. In contrast to the analysis of the smaller group photo, which produced a consistent identification of a single target, a different outcome emerges here: The graph reveals a series of peaks, indicating that several faces exhibit a degree of resemblance to David.

To analyse these data in more detail, the three identities from the large group photo with the highest similarity ratings to the comparison images are examined further. These identities are shown in Figure 7, ordered by similarity (from top to bottom) for each comparison image. The mean similarity ratings for the top three identities are also provided, based on the average that the AFRS generated for each identity against all of the comparison images. Some notable consistencies emerge from this display. The identity with the highest average similarity rating (of 71.36) is ranked first against two of the four comparison images (David 3 and 4) and ranked second against the other two (David 1 and 2). Moreover, in the two top-ranked cases, this person is identified *as David* above the identification threshold of the AFRS (similarity > 86). These instances are highlighted in green. This is the only identity from the large group photo to achieve such high similarity ratings. It is notable that one of these identifications is achieved in comparison with David's face from the postcard group photo in Figure 4, which might provide a closer match than the three portraits (David 1–3) to the large group photo in terms of image quality and resolution, as well as the age of David at the point in time when these photographs were recorded.

However, another person from the group photo performs sufficiently close to cast doubt on whether the top-performing identity *really* is David. This person is the top match for David 1 and 2, and ranks second for David 3 and 4. Moreover, the mean similarity of this person, averaged across the four comparison images, is reasonably close to the top match (61.40 vs. 71.36). Thereafter, these ratings fall sharply and results were inconsistent. For example, the mean similarity rating for the




**Figure 7.** The top three matches in the large group photo for each comparison image of David. The fifth column shows the overall top three matches, based on the mean similarity ratings (far right) for each identity against all comparison images of David. The faces with green borders indicate an identity match that exceeds the identification threshold of the AFRS.

third-ranked identity was 42.31, and seven different identities occupied the fourth- and fifth-ranked places across the four comparison images of David. The average similarity score for the full set of 148 identities against the four comparison images was 6.69.

## Elimination of Potential Identity Matches

In a next step, we sought to examine if any of the top-three identities could be *eliminated* from consideration. First, a comparison of the top three potential matches from the large group photo (Figure 1) against all identities in the postcard group photo (Figure 4) was made. As David's match is known in Figure 4, any identity matches between the top three faces identified by the AFRS in the large group photo and *other* people in the small group photo can be eliminated as David. Consistent with the analysis in Figure 6, this reveals only a single identity match (with a similarity rating of 93.29) for the top hit by the AFRS in Figure 6 for the comparison image of David's face in Figure 4. No other identity matches are found. Therefore, this analysis cannot eliminate any of the other top AFRS hits from the investigation (for the full data set, see https://osf.io/bp5s3/).

Given the lack of any identity matches between the top three and the small group photo in Figure 4, a third group photograph depicting soldiers from the 225 Field Ambulance of the 6th British Airborne was added to this investigation. This is reproduced in Figure 8 and was initially discarded from this investigation, as comparison of the soldiers in this photograph with the three portraits of David in Figure 2 indicated that *none* provide an identity match. However, the question of main interest *now* is whether any of these men provide a match to the top-ranked identities from the large group photo. By process of elimination, this might make it possible to determine which of the top five matches from the large group photo are *unlikely* to be David. A comparison of the top-ranked identities from the large group photo with all identities depicted in Figure 8 reveals a strong match with a similarity score of 99.99 – for the second-most similar identity listed by the AFRS in Figure 7.[2] Considering that there is no match to any of the comparison photos of David with the identities in Figure 8, and that a person in this group photo provides an identity match to the second-ranked person by the AFRS for the large group photo, this implies that this identity is probably *not* David. Therefore, this person is eliminated from the investigation.

While our initial aim was to identify David from facial information alone, at this point additional non-facial information was drawn upon that might help to corroborate the decision of the AFRS. For




**Figure 8.** The second small group photo. None of the men in this photo is an identity match to David's portraits in Figure 2. However, one is a strong match to the second-ranked identity by the automatic face recognition system (AFRS) in the large group photo, which is shown in the green inset (top left).

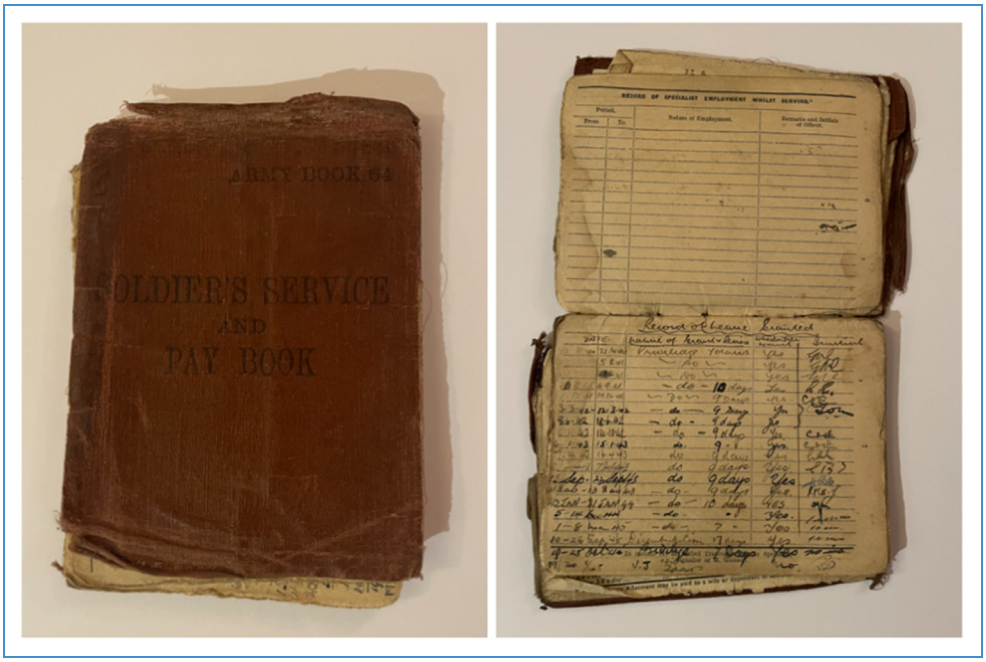



**Figure 9.** Record of leave from David's Soldier's Service and Pay Book.

this purpose, the position of the top match in the group photograph in Figure 1 was considered. He is seated in the middle of the front row above the word 'ambulance'. These positions are reserved for officers, as is also evident from the uniforms. David likely held the rank of *Private* at the time this

group photo was taken and never rose above the rank of *Corporal* during his time in the military. This observation leads to a surprising realisation: the top match of the AFRS, and the only person identified *above threshold* (twice), cannot be David; it is a false positive. We continued to look for further contextual evidence. During this search, David's 'Soldier's Service and Pay Book' was found (see Figure 9). This includes a 'Record of Leave', which shows that he was granted 10 days' leave from 20 to 31 January 1944. Inspection of the group photo in Figure 1 shows that this was recorded in the same month, though no exact date is specified. This raises the possibility that David is not present in this photo at all.

## Conclusions

This single-case study shows that person identification from old imagery is challenging even with modern technology and scientific method. Family members could not identify soldier David Ferguson, and forensic facial examiners would not attempt identification due to the low-quality imagery. However, the most surprising result reflects the false positives generated by the AFRS. It was only possible to establish this because of contextual information provided by the army uniforms. Otherwise, it would have been tempting to accept the AFRS's top match as the correct answer, given the system's strong performance on the KFMT and its correct identification of David from the smaller group photo in Figure 4. These findings have implications for person identification in applied contexts. While AFRSs are becoming widespread in policing to improve security and efficiency, misidentifications in these settings can be difficult to detect and document. This study demonstrates that such cases can occur *repeatedly* for the same identity – in the case documented here, the same identity was misidentified above the threshold for two different comparison images.

This case study also suggests that such problems arise because 'challenging' images remain difficult to process for humans *and* AFRSs (Cavazos et al., 2021; Parde et al., 2023; Phillips et al., 2012). In images that capture a person in natural settings, facial appearance is influenced in complex ways by factors such as lighting and view (Bindemann et al., 2013; Estudillo & Bindemann, 2014; Jenkins et al., 2011; Longmore et al., 2008). Variation induced by such factors is also evident for the top three matches by the AFRS. For example, some of these identities are shown in a frontal view and with even lighting, whereas others are shown in mid-profile and illuminated heavily from the side (see top three matches for each comparison image in Figure 7). Thus, similarity ratings by the AFRS for these two faces are not *directly* comparable, as different factors are at play in each image that might undermine identification. This is an important point to note – that the equivalence of the conditions under which such facial comparisons are made cannot be assumed, even when two face images are derived from the same substrate.

The question arises of how AFRS should be supervised by humans to detect possible errors. This issue is not easily resolved as observers are biased by AFRS decisions (Carragher & Hancock, 2023; Fysh & Bindemann, 2018b; Mueller et al., 2024). However, when independently-made human and AFRS decisions are combined, overall identification accuracy can improve (Phillips et al., 2018). In a sense, this is also evident here, as background information about military rank found by the human observer served to correct the AFRS. Without such additional evidence to cross-check AFRS decisions, caution must be exercised even when multiple positive identifications of the same person are made, as such seemingly compelling cases can nonetheless be misleading.

The principal message from this case study is therefore one of caution. The data demonstrates that AFRSs can produce convincing false-positive identifications, especially when the same incorrect identity is matched above threshold on several occasions. This case study also illustrates the importance of integrating facial comparison with contextual evidence, such as military rank, photograph position, and historical records, to evaluate the plausibility of candidate matches. At the same

time, it remains impossible to determine at this point whether David Ferguson appears elsewhere in the large group photograph or is absent from it altogether. This uncertainty reflects an inherent limitation of historical person identification, where image quality, uncontrolled photographic conditions, and incomplete documentary evidence constrain the conclusions that can be drawn. More broadly, the findings should not be interpreted as estimates of the false-positive performance of AFRS in general, as this study presents a single historical case involving one commercial AFRS, one target identity, and a limited set of comparison images. The key contribution of this case study lies in providing a cautionary demonstration that apparently compelling facial matches can be misleading, and that reliable identification requires facial comparison to be interpreted alongside independent contextual evidence.

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## Author Contribution(s)

**Markus Bindemann:** Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Resources; Supervision; Visualization; Writing – original draft; Writing – review & editing.

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## Declaration of Conflicting Interests

The author declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: The author declares a personal relationship with the individual at the centre of this case study. David Ferguson was the grandfather of the author's wife, Heather Ferguson, and the author knew him personally during his lifetime. This relationship is relevant to the historical context of the case and may be perceived as a potential conflict of interest with respect to the identification attempt described in this article.

## Notes

1. The similarity data and matching decisions from the AFRS for all comparisons reported in this article can be accessed at https://osf.io/bp5s3
2. The AFRS actually reports two identity matches (i.e., with a similarity rating exceeding decision threshold) for this person in the small group photo in Figure 8. The second match is the person furthest to the right in the front row, with a similarity rating of 94.60.
3. The correct answers are, from top left to bottom right: match, non-match, non-match, match.

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