

LAST BUT NOT LEAST

The Lee Harvey Oswald backyard photos: real or fake?

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Abstract. Ever since the assassination of US President Kennedy, numerous theories have circulated purporting that Lee Harvey Oswald, the accused assassin, acted as part of a larger criminal conspiracy. It has been suggested, for example, that incriminating photographs of Oswald were manipulated, and hence evidence of a broader plot. Specifically, it has been argued that the lighting and shadows in these photos are physically impossible. Because the visual system is often unable to reliably judge 3-D geometry and lighting, a detailed 3-D analysis of the Oswald photos to determine if claims of tampering are warranted.

we performed

United States President John F Kennedy was assassinated on November 22nd 1963. Shortly afterwards, Lee Harvey Oswald was arrested and charged with the crime. Because he was killed before his trial, however, many questions surrounding the assassination remained unanswered. Since this time, numerous theories have circulated suggesting that Oswald acted as part of a larger criminal conspiracy involving a variety of government, international, or criminal groups. These conspiracy theories are not just the province of a small minority; a 2003 ABC News poll⁽¹⁾ found that 70% of Americans believe that Kennedy's death was the result of a broader plot.

Many of these theories point to purported inconsistencies in the events of November 22nd, and in the evidence collected against Oswald. One such example includes the photographs of Oswald in his backyard holstering a pistol, and holding a rifle in one hand and Marxist newspapers in the other (figure 1). Oswald claimed that these photos were fake. In addition, many have argued that the shadow cast by his body onto the ground, and the shadow under his nose are inconsistent with a single light source, and hence evidence of a photographic fake. At first glance, these shadows may seem to be the result of two different lights: one directly above Oswald giving rise to the shadow under his nose, and the other in front of and to the left of Oswald, giving rise to the shadow on the ground.

It has previously been pointed out, however, that the human visual system can be quite inept at judging inconsistencies in lighting and shadows (Farid and Bravo 2010; Ostrovsky et al 2005). Rather than rely on subjective analysis, we constructed a 3-D model of Oswald's head and 3-D models of portions of the backyard to determine if the shadows in this photo could be explained by a single light source.

A 3-D model of Oswald's head was constructed from his police mug shots (figure 2) using FaceGen (Singular Inversions). This 3-D model was then combined with a generic articulated 3-D body⁽²⁾, and rendered in the 3-D modeling software Maya (Autodesk). The ground plane, post under the stairs, and fence were created from simple 3-D primitives. The scene geometry, camera position, and direction of a distant light source (ie sun) were manually positioned until they matched the original photo shown in figure 1.

⁽¹⁾ ABC News poll: Who killed JFK?—September 11, 2003.

⁽²⁾ Alfred 1.2.0: <http://www.creativecrash.com/maya/downloads/character-rigs/alfred>



Figure 1. Lee Harvey Oswald in his backyard (top) and a magnified view of his head (bottom). Are the shadows in this photo inconsistent with a single light source?

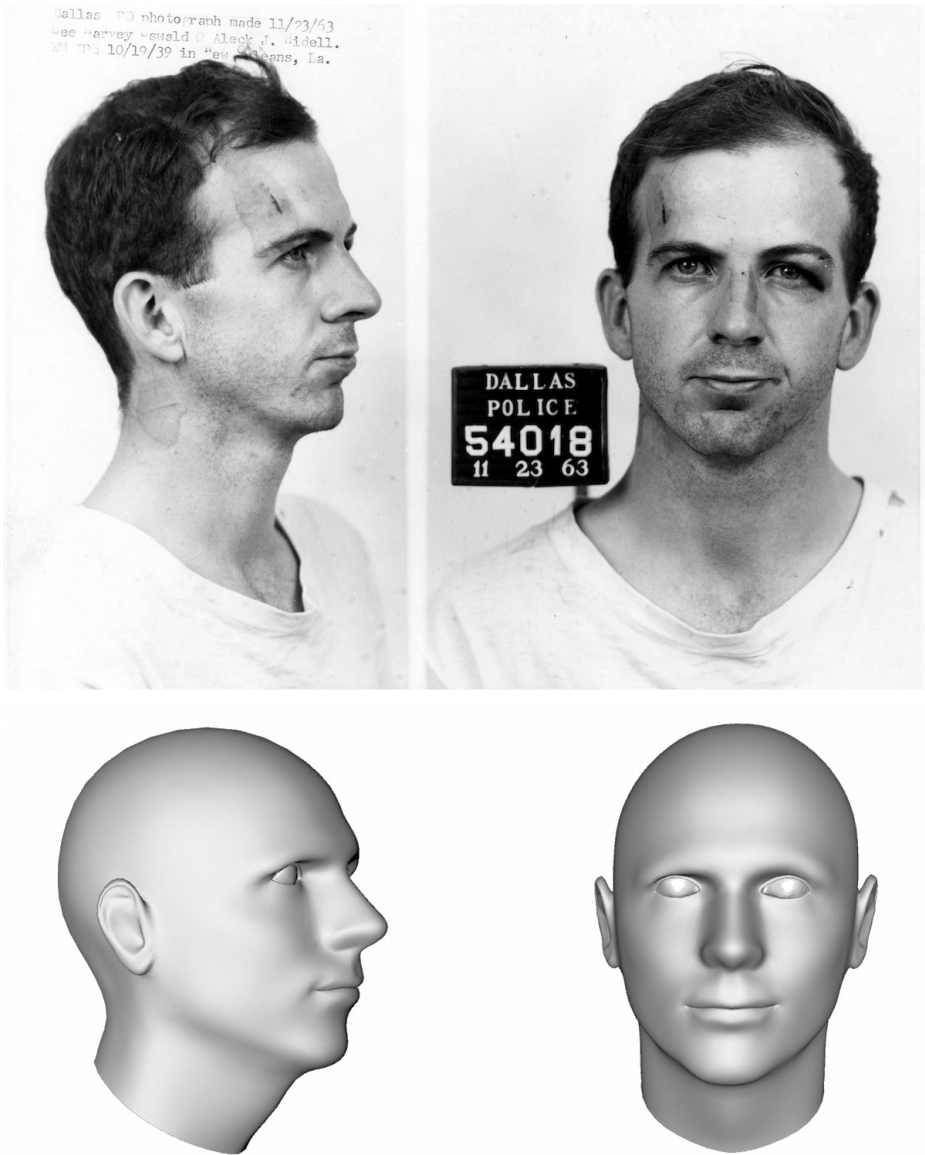


Figure 2. A profile and frontal view of Oswald (top) are used to construct a 3-D model (bottom).

Shown in figures 3 and 4 are the rendered 3-D models and the original photo. Note that in figure 3, the shadows under the nose, eyes, lower lip, and neck are well matched between the model and the original. At the same time, the shadow cast by the body onto the ground plane is also well matched with the original (figure 4). Note also that the thin sliver of a shadow from the vertical post is also well matched. These shadows, which at first glance appeared inconsistent, are in fact perfectly consistent with a single light source.

Evidence of tampering in this historical and controversial photo would have suggested a broader conspiracy behind Kennedy's assassination. A 3-D lighting and shadow analysis of this photo, however, reveals no such evidence of tampering. Claims to the contrary are a result of the inability of the visual system to reliably judge 3-D geometry and lighting from a photograph.

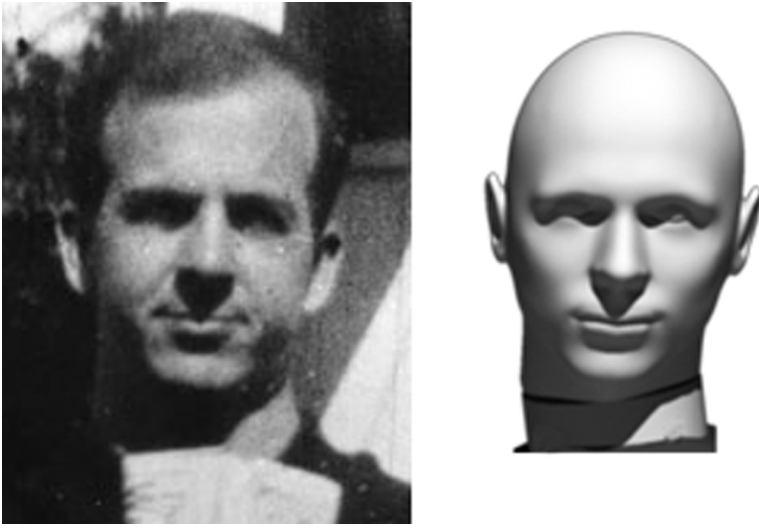


Figure 3. Oswald's head and the 3-D model—the shadows under the nose, eyes, lower lip, and neck are well matched.



Figure 4. Oswald in his backyard (left), a 3-D reconstruction (middle), and a superposition of the reconstruction and the original (right)—the scene geometry and shadows are well matched.

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