HUMANS VS. AI: PERCEPTUAL ESTIMATES OF THE PHYSICAL ATTRIBUTES OF PEOPLE IN PHOTOGRAPHS

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Motivations

Forensic identification is riddled with bias and errors[with flawed forensic techniques contributing to almost one-quarter of wrongful convictions in the US.

For example, in the photo below of an armed robbery, witnesses identified the suspect as 5'6" but a forensic examiner measured the height at 6'1" implicating and eventually leading to the wrongful conviction of George Powell who stands at 6'3".

Many factors make it challenging to accurately estimate height and weight from a single image:

- Due to spinal compression, height fluctuates daily by up to 1.9 cm
- Due to body pose, apparent height in an image can vary by up to 6 cm
- Shoes, hair, and headwear further obscure a person's true height.

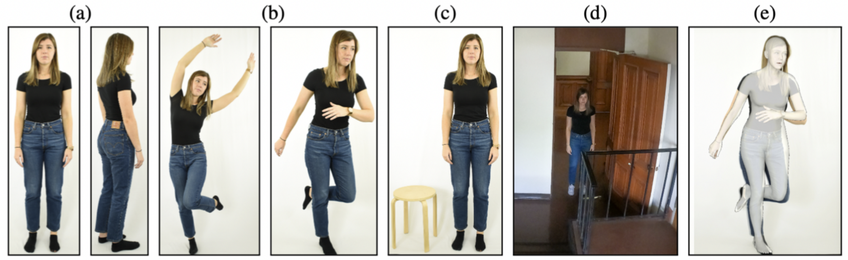
Research Questions

We evaluate the accuracy with which AI-based tools, and for comparison, expert photogrammetrists and non-experts can estimate a person's height and weight from a single image. We address the following questions:

- Given flaws in current forensic methods, can we use AI to estimate a person's height and weight from a single photograph?
- How does the AI compare to experts and non-experts?

Methods

Volunteers (n=58) had their height and weight measured, and then photographed in (a) neutral and (b) dynamic poses in a studio with no surrounding structures and with (c) one reference object; and in (d) an in-the-wild setting in a hallway surrounded by familiar structures (doorway, stairs).

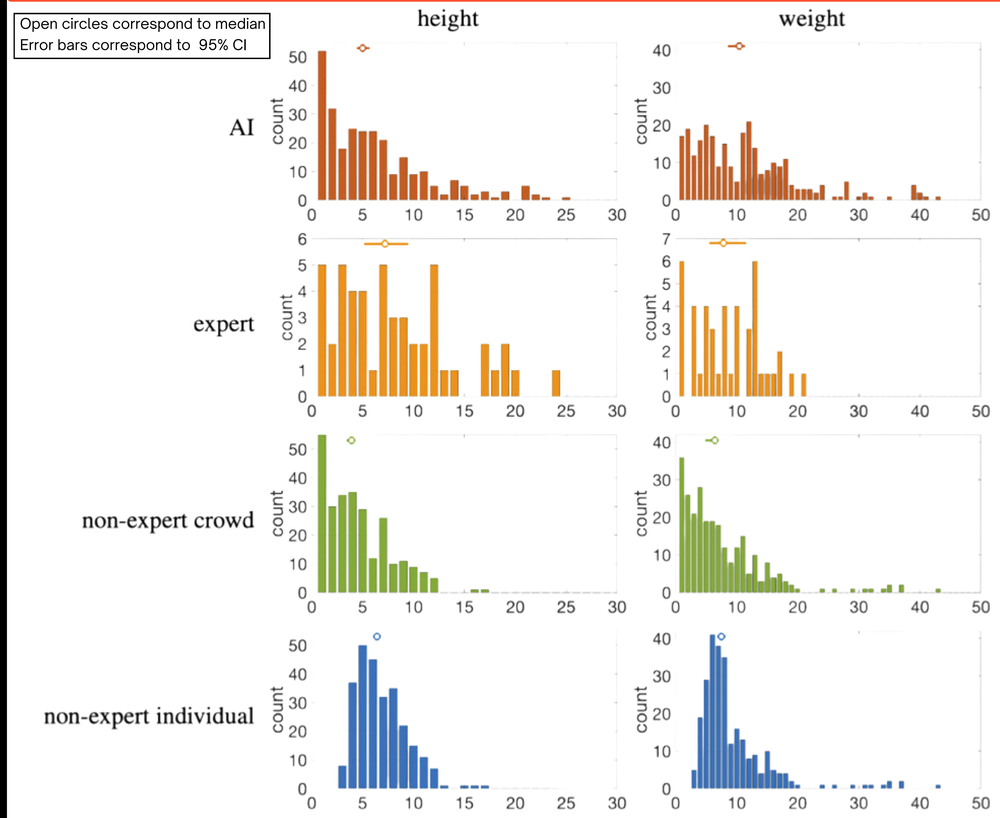


AI: a state-of-the-art, deep-learning based system was used to estimate (e) the 3D body pose and shape (scaled to be consistent with a gender-specific, inter-pupillary distance) from which height/weight was estimated.

Experts: ten licensed photogrammetrists were recruited to provide height and weight estimates each for a sample of five in-the-wild photos.

Non-experts: study participants (n=325) recruited from Mechanical Turk were asked to estimate the height/weight of the volunteers depicted in 58 photos.

Results



In-the-wild median absolute height/weight error:

- **AI:** 5.0cm/10.4kg
- **Experts**: 7.2cm/7.8kg
- **Non-expert:** 6.4cm/7.5kg
- **Non-expert (pooled):** 3.9cm/5.8kg

Studio median absolute height/weight error:

- **AI:** 7.3cm/8.0kg
- **Experts:** N/A
- **Non-expert:** 8.4cm/9.1kg
- **Non-expert (pooled):** 5.5cm/6.7kg

Conclusions

A small group of non-experts outperforms AI and experts in height/weight estimation, even when the non-experts are provided with less information.

Looking forward, we want to understand:

- How are non-experts estimating height and weight in the absence of cues?
- How can we improve the performance of the AI?

References

[1] Gerke, D. A., Brismée, J.-M., Sizer, P. S., Dedrick, G. S. & James, C. R. Change in spine height measurements following sustained mid-range and end-range flexion of the lumbar spine. Appl. Ergon. 42, 331–336 (2011). [2] Criminisi, A., Zisserman, A., Gool, L. J. V., Bramble, S. K. & Compton, D. New approach to obtain height measurements from video. In (ed Higgins, K.) Investigation and Forensic Science Technologies, vol. 3576, 227–238. International Society for Optics and Photonics (SPIE, 1999). [3] Dror, I. E. Cognitive and human factors in expert decision making: Six fallacies and the eight sources of bias. Anal. Chem. 92, 7998–8004 (2020).Return to ref 9 in article. [4] National Research Council Committee on Identifying the Needs of the Forensic Sciences Community. Strengthening forensic science in the United States: A path forward (National Academies Press, 2009). [5] Edwards, H. T. Ten years after the National Academy of Sciences' landmark report on strengthening forensic science in the United States: A path forward—where are we? SSRN 3379373 (2019). [6] Barrington, S., Farid, H. A comparative analysis of human and AI performance in forensic estimation of physical attributes. Sci Rep 13, 4784 (2023). https://doi.org/10.1038/s41598-023-31821-3