DG JRC Study on Age and Ageing in Fingerprints

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WHY? MOTIVATION

BIOMETRICS PARADIGM: You are your own key.

For this paradigm to be applicable biometric characteristics need to present a high level of PERMANENCE.

BIOMETRIC PERMANENCE: ability to reliably acquire and recognise over time a biometric characteristic.

There may be difference in performance among age-groups. Practical implications:

- **EU commitment for the rights of the elderly**
- **Border control: strategies according to age**
- **Passport: different renewal policies**
- **Law enforcement: missing children/elders**

WHAT? OBJECTIVE

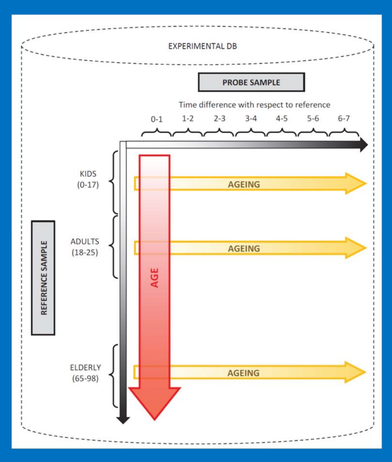
AGE AND AGEING EFFECTS IN FINGERPRINTS.

How does time affect fingerprint performance?

How does fingerprint quality evolve through time?

Are there difference among age groups?

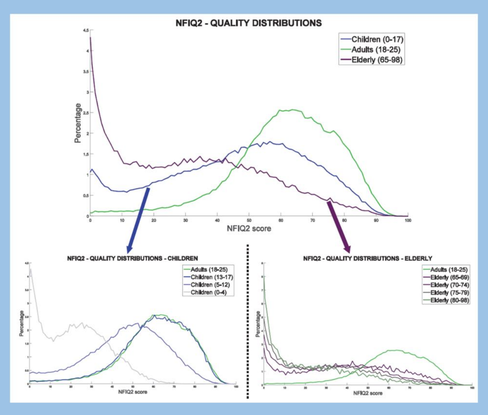
When is time difference between two samples too large?

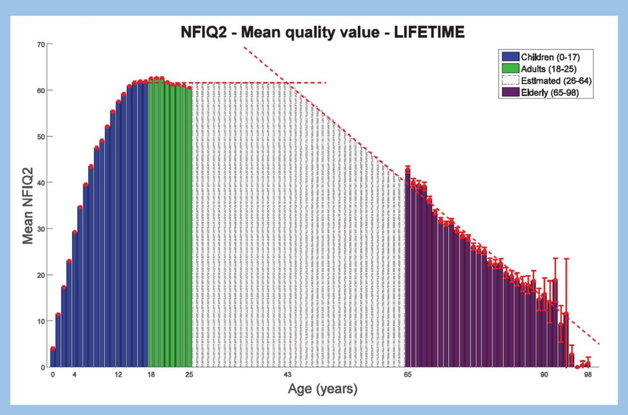


HOW? PROTOCOL

1. **DATABASE: real operational conditions. Issuing of Passports. Flat fingerprints, 500 dpi, optical.**
   - **400K fingerprint images**
   - **250K different fingers**
   - **0-25 years and 65-98 years.**
   - **7 years difference between matching pairs**
2. **QUALITY experiments: NFIQ2, NFIQ1, VERIQ**
   - **Quality distributions**
   - **Evolution mean quality value**
3. **MATCHING experiments: VERIFINGER, NIST**
   - **DETs**
   - **Evolution mean genuine matching scores**

AGE EFFECT: Quality Experiments

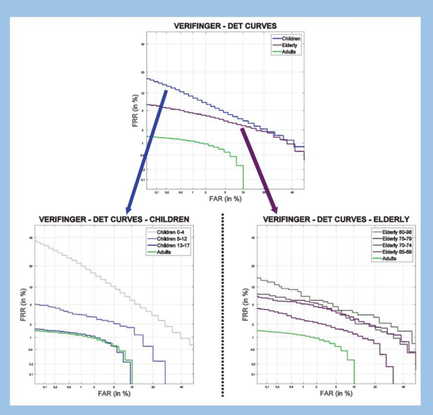


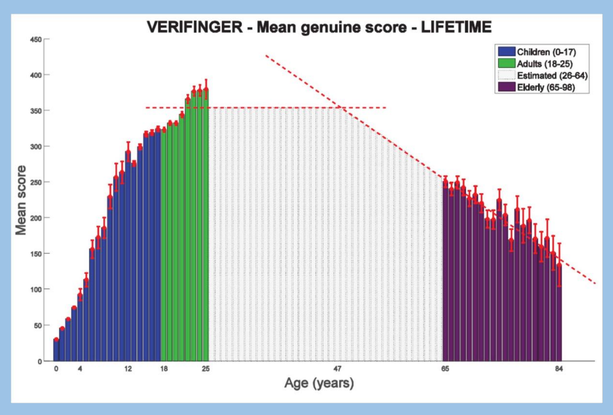


FINDINGS

1. **Most problematic group in terms of quality: THE ELDERLY.**
2. **CHILDREN: low quality for 0-4. Medium quality for 5-12. Quality equivalent to adults for 13-17.**
3. **ELDERLY: linear degradation of quality from 65 to 98.**
4. **Linear degradation of quality starts at around 40-45 years of age (estimation).**

AGE EFFECT: Matching Experiments

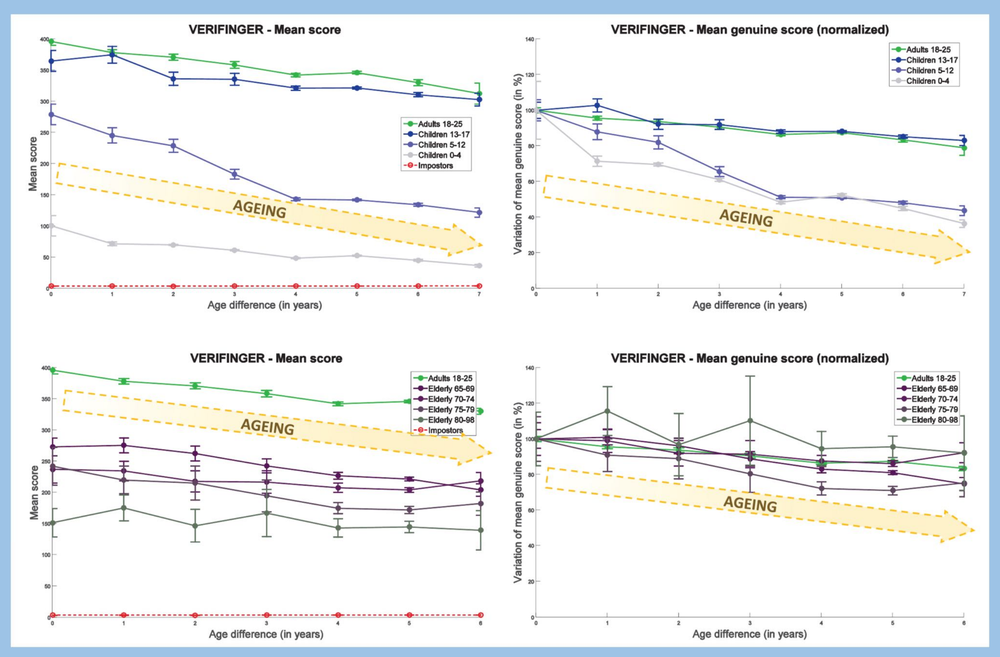


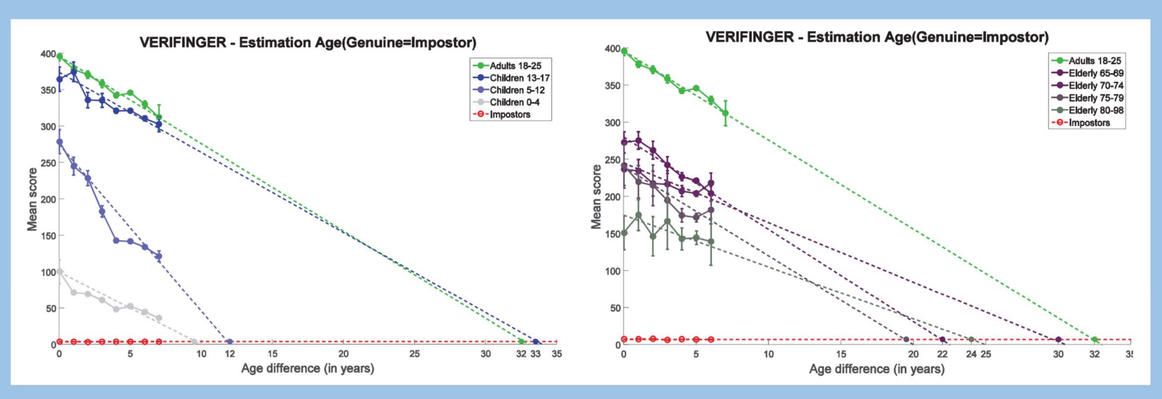


FINDINGS

1. **In terms of matching ELDERLY perform somewhat better than children (NOT consistent with observation on quality)**
2. **CHILDREN: low performance for 0-4. Medium performance for 5-12. Performance equivalent to adults for 13-17.**
3. **ELDERLY: linear degradation of performance from 65 to 98.**
4. **Performance degradation starts at around 40-45 years of age (estimation).**

AGEING EFFECT

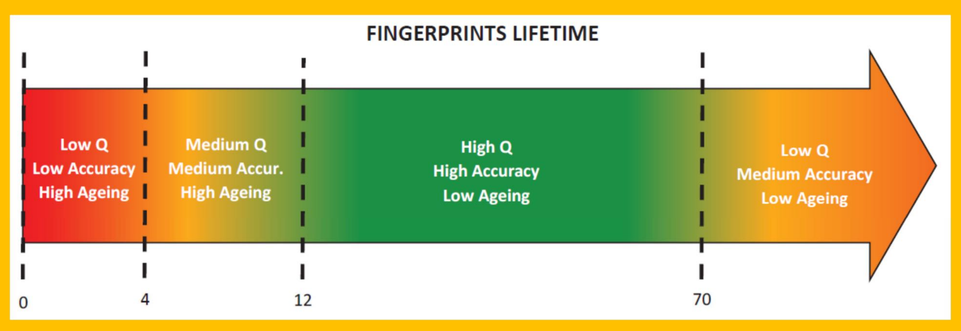




FINDINGS

1. **For all age groups a larger time difference between reference and probe samples implies a larger degradation in the genuine scores: AGEING IS CONFIRMED.**
2. **Adults and children 13-17, genuine matching decrease of around 15% in 7 years.**
3. **Children 5-12 and children 0-4, genuine matching decrease of around 50% in 7 years.**
4. **All elderly groups, genuine matching decrease of around 30% in 7 years.**

CONCLUSIONS



HYPOTHESES

1. **HYPOTHESIS 1: developing specific quality metrics and matching algorithms adpated to the reduced size of children fingerprints could significantly improve both their image quality scores and their overall accuracy.**
2. **HYPOTHESIS 2: new touchless acquisition devices could improve the quality and, therefore, the matching performance of elderly fingerprints.**
3. **HYPOTHESIS 3: the development of a reliable growth model for fingerprints between 0 and 12 years could help to predict the new position of minutiae points and other distinctive features at a certain point in the future, with respect to the reference template, helping this way to reduce the ageing effect in young children**

REFERENCES

1. Laurent Beslay, Javier Galbally and Rudolf Haraksim, "Automatic Fingerprint Recognition: from Children to Elderly. Ageing and Age Effects", *JRC Technical Reports*, EUR 29265 EN. Available at: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC110173/jrc_fingerprint_children_elderly_study_v.final.pdf
2. Javier Galbally, Rudolf Haraksim and Laruent Beslay, "Fingerprint Quality: a Lifetime Story", in *Proc. Intl. Conf. of the Biometrics Special Interest Group (BIOSIG)*, 2018
3. Javier Galbally, Rudolf Haraksim and Laurent Beslay, "A Study of Age and Ageing in Fingerprint Biometrics", *IEEE Trans. on Information Forensics and Security*, 2019 (to appear)