

To a personalized and inclusive anti-ageing experience: leveraging AI-automated assessment of facial signs and their respective weights on human perception

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L'OREAL RESEARCH & INNOVATION

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# UNDERSTAND ALL SKIN DIMENSIONS WITH ENVIRONMENTS & LIFESTYLES



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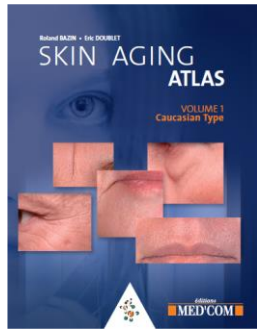
Consumers or clinical researchers enter in a new era, benefiting of emergence of personal smartphones with powerful hardware and high-resolution cameras. Conducting epidemiological studies on large cohorts, in specific environments/lifestyles, require new embarked automatic grading system to detect and quantify facial signs from selfies.



Ambition of an inclusive AI-based automatic grading system

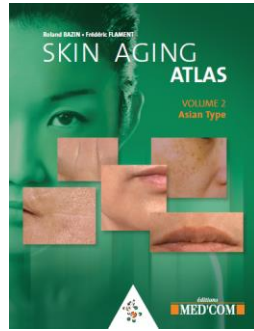
# SKIN AGING ATLAS FOR DERMATOLOGISTS AND EXPERTS

Standard clinical photographic scales to bring repeatability and reproducibility



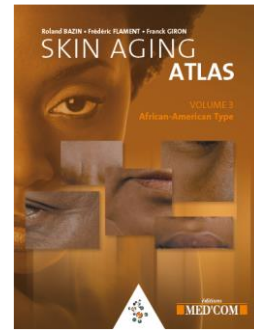
2007

EUROPEAN WOMEN & MEN



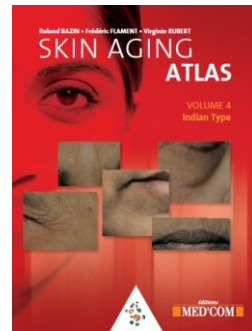
2011

EAST-ASIAN WOMEN & MEN



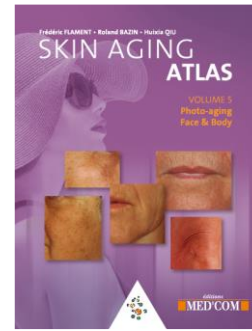
2013

AFRICAN-AMERICAN WOMEN & MEN



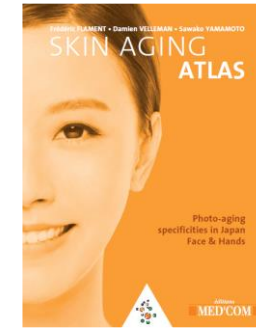
2015

INDIAN WOMEN & MEN



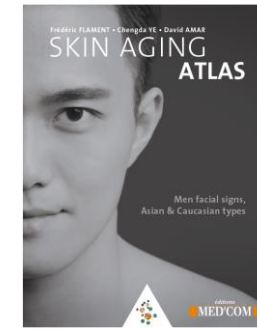
2017

PHOTO-AGING WOMEN FACE & BODY



2019

PHOTO-AGING JAPANESE WOMEN FACE & HANDS



2023

EUROPEAN, EAST-ASIAN MEN APPEARANCE

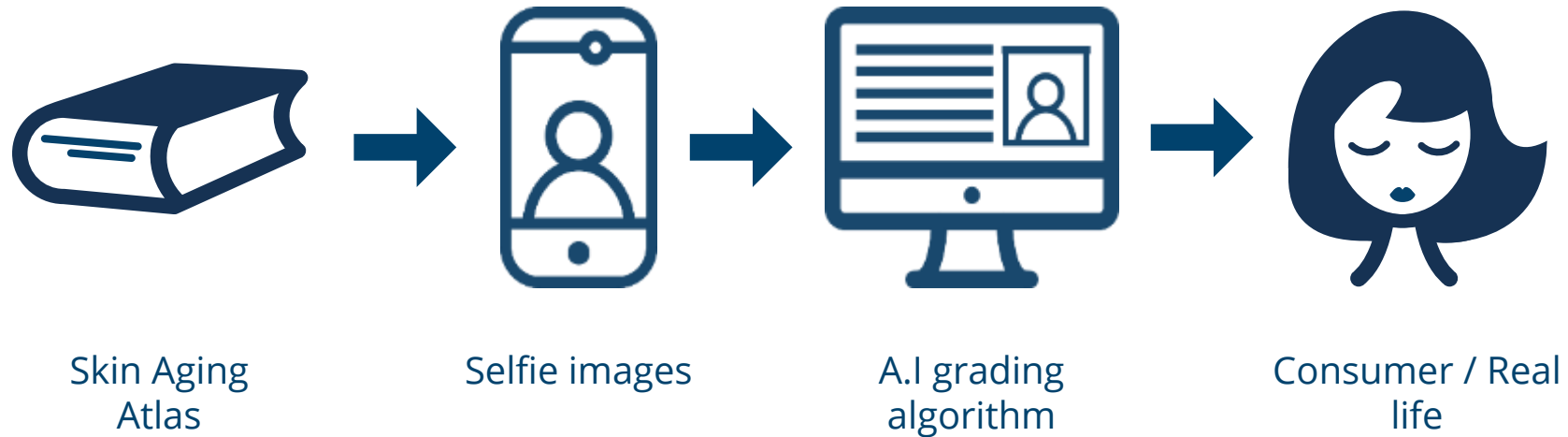
Precise description of the sign & its evaluation

A series of pictures, describing different level of severity

Wrinkles & skin texture		Ptosis & sagging		Photo-aging specificities - appearance & texture						
<p><b>Asian women facial skin atlas</b></p>	<p><b>Crow's feet wrinkles</b></p> <p><b>DEFINITION</b> Wrinkles in the area of the outer eye corners are generally called "wrinkles of the crow's feet".</p> <p><b>AREA</b> Laterally fan-shaped area extending from the outer corner of the eye towards the hairline, according to the part where upper eyelid droops. In many cases, the evaluation starts at least 5 mm outside from the corner of the eye.</p> <p><b>EVALUATION</b></p> <ul style="list-style-type: none"> <li>→ Evaluate the depth of the deepest wrinkle.</li> <li>→ Do not take into account the number of wrinkles.</li> <li>→ Do not take into account the length of wrinkles.</li> <li>→ Do not take into account scars.</li> </ul>	<p><b>Asian women facial skin atlas</b></p>	<p><b>Drooping of the upper outer eyelid</b></p> <p><b>DEFINITION</b> During the aging, the superior eyelid subsides on its external part so that covers the upper edge of the eye.</p> <p><b>AREA</b> The superior eyelid in its external part.</p> <p><b>EVALUATION</b></p> <ul style="list-style-type: none"> <li>→ Estimate the quantity of the ptosis of the upper eyelid in its external part compared to the external level of the palpebral fissure (i.e. corner of the eye).</li> <li>→ Do not take into account scars.</li> </ul>	<p><b>GRADE 0</b></p>	<p><b>GRADE 1</b></p>	<p><b>GRADE 2</b></p>	<p><b>GRADE 3</b></p>	<p><b>GRADE 4</b></p>	<p><b>GRADE 5</b></p>	<p><b>GRADE 6</b></p>

## BRING NEW CLINICAL DATA TO USERS

Transform Skin Aging Atlas standards and associated knowledge





Creation of an inclusive AI-based automatic grading system

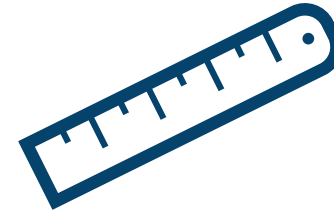
## LEARNING DATABASE

Selection of graded images covering diversity of usage

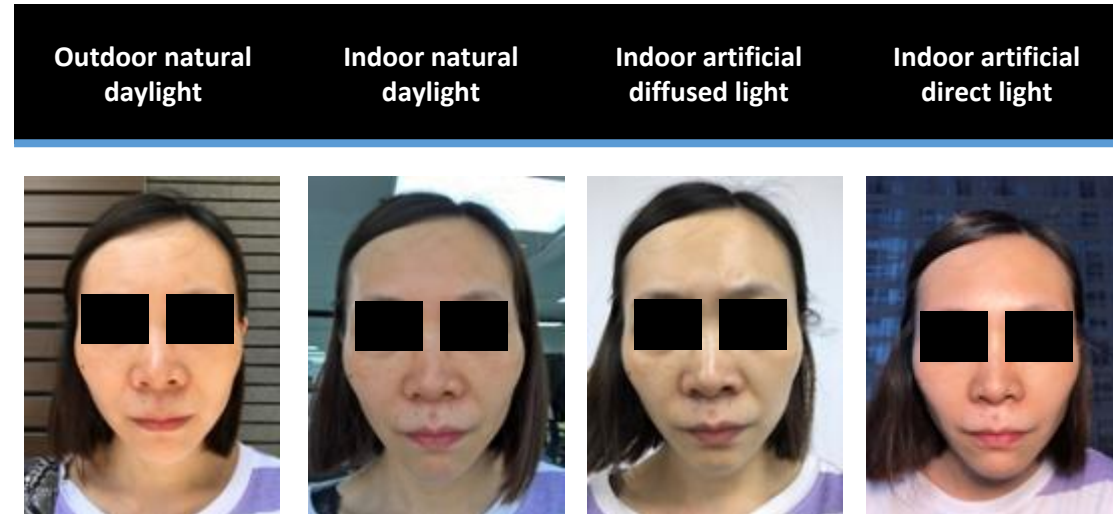
- 15,000 images of both gender
- 4 lighting conditions
- Photo-types I-VI
- 15 experts/dermatologists
- 15 facial signs on selfies



Selfie images

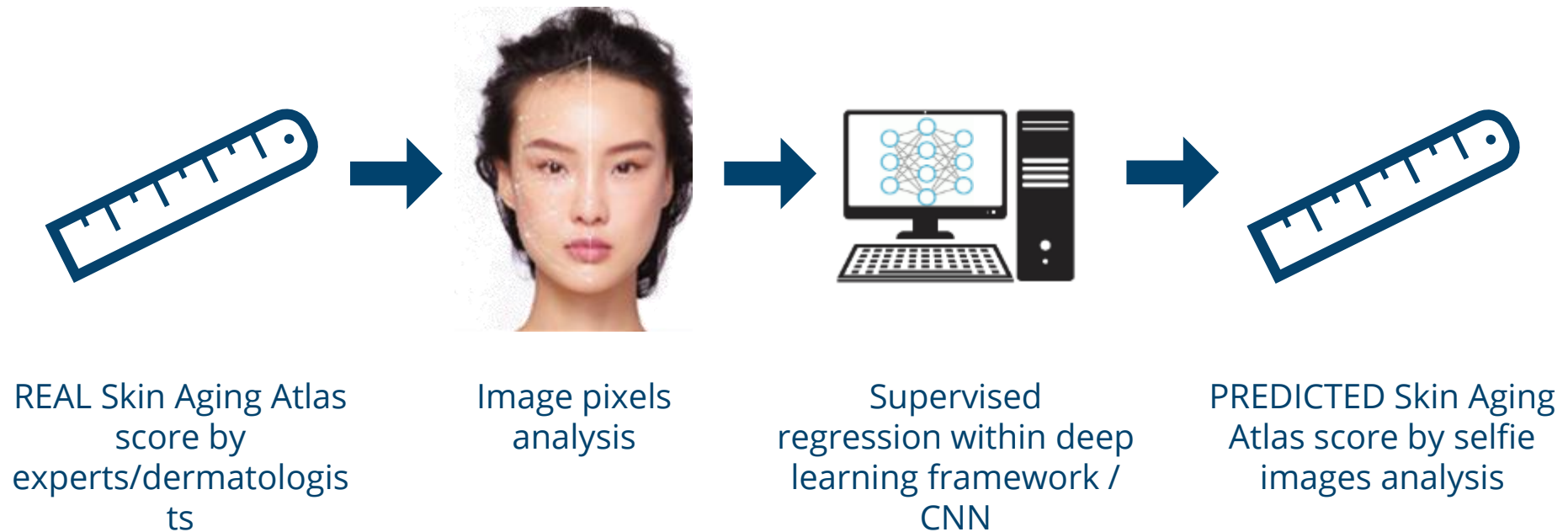


Experts' score on selfie images



# PROCESS OF TRAINING FOR A.I GRADING ALGORITHM

Supervised learning based on clinical scores from Skin Aging Atlas

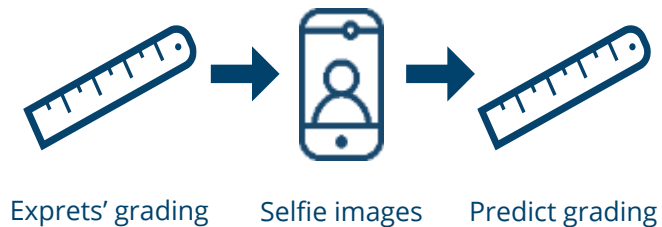
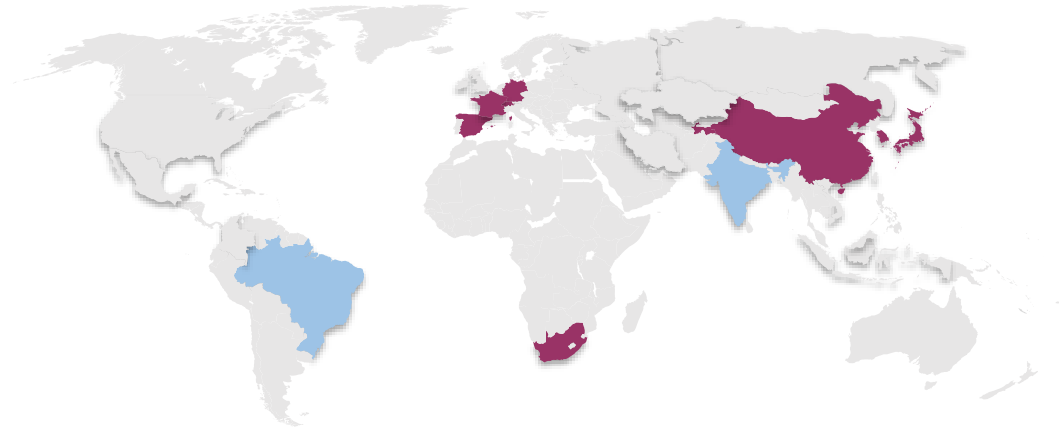




# ACCURACY AND ROBUSTNESS OF PREDICTION

How efficient is prediction of Skin Aging Atlas scores on real life selfies?

- 1,500 men & women (20–75y)
- Photo-types I to VI (7 countries)
- 15 experts/dermatologists
- 15 facial signs on selfies
- 2 scientific publications



Facial signs	A.I Error	Experts Error	Facial signs	Variability
Wrinkles	0.30	0.60	Wrinkles	12 %
Sagging	0.25	0.55	Sagging	10 %
Pigmentation	0.40	0.65	Pigmentation	11 %
Vascular	0.22	0.50	Vascular	10 %
Cheek pores	0.30	0.55	Cheek pores	11 %

**HIGHER ACCURACY FOR ALGORITHM VS. EXPERTS'. ROBUST VS. EXPRESSIONS, POSITIONS, DISTANCE OR LIGHT.**

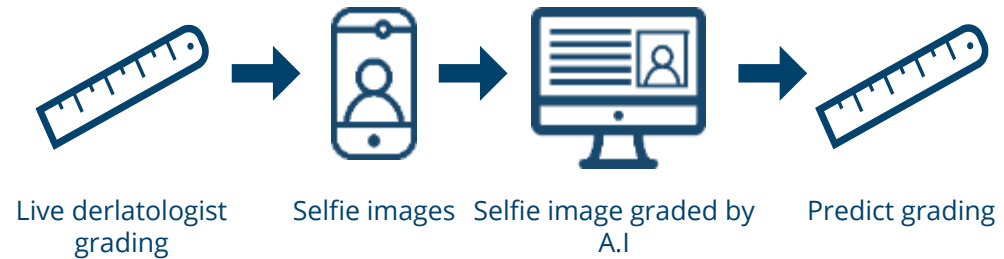


Validation of accuracy and relevance of an  
inclusive AI-based automatic grading system

# VALIDATION BY DERMATOLOGISTS

Prediction of live grading with selfies analysis

- 579 women (20–75y)
- 10 dermatologists
- 5 cities in Europe & Asia
- 15 facial signs on selfies
- 3 scientific publications



Facial signs	Correlation	Significance
Wrinkles	$r = 0.90$	$p < 0.0001$
Sagging	$r = 0.90$	$p < 0.0001$
Pigmentation	$r = 0.70$	$p < 0.0001$
Vascular	$r = 0.80$	$p < 0.0001$
Cheek pores	$r = 0.60$	$p < 0.001$

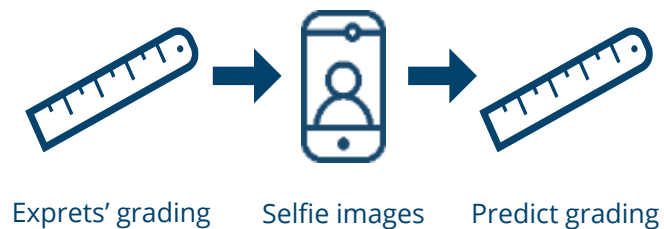
More impact of camera resolution

A.I GRADING HIGHLY-CORRELATED WITH ASSESSMENTS BY DERMATOLOGISTS FOR VERY PREDICTIVE SCORES.

# DIVERSITY & INCLUSIVITY

Unique study in US to demonstrate accuracy of A.I-based automated grading system

- 1,041 US women (20–80y)
- All phototypes, ancestries, ages
- Northeast, Midwest, South, West
- 7 facial signs on selfies
- 50 Dermatologists with diversity



Sub-groups	N	Forehead wrinkles	Periorbital wrinkles	Nasolabial fold	Density of pigmentary spots	Ptois lower face	Diffused redness	Cheek pores	Average
Global panel	1,041	0.83	0.79	0.90	0.40	0.91	0.79	0.63	0.75
Non-Hispanic Euro-American	313	0.87	0.86	0.91	0.62	0.92	0.78	0.63	0.80
African American	280	0.86	0.76	0.90	0.28	0.89	NA	0.64	0.72
Hispanic Euro-American	253	0.86	0.85	0.89	0.33	0.90	0.80	0.69	0.74
East Asian	195	0.89	0.84	0.92	0.26	0.92	0.65	0.69	0.76
18y–29y	249	0.69	0.61	0.71	0.37	0.66	0.80	0.58	0.63
30y–39y	245	0.77	0.69	0.79	0.37	0.75	0.78	0.69	0.69
40y–49y	223	0.78	0.67	0.80	0.49	0.73	0.78	0.60	0.69
50y–64y	196	0.79	0.70	0.80	0.56	0.79	0.77	0.50	0.70
65y –80y	128	0.73	0.60	0.77	0.53	0.72	0.76	0.45	0.65
Phototype I	77	0.88	0.88	0.89	0.57	0.91	0.84	0.64	0.80
Phototype II	216	0.83	0.83	0.90	0.46	0.92	0.70	0.59	0.75
Phototype III	294	0.83	0.78	0.90	0.43	0.91	0.79	0.60	0.75
Phototype IV	259	0.83	0.73	0.92	0.43	0.92	0.80	0.68	0.76
Phototype V	138	0.78	0.71	0.86	0.16	0.82	0.76	0.69	0.68
Phototype VI	57	0.68	0.59	0.87	0.17	0.82	NA	0.66	0.63

IN THIS “INCLUSIVE” STUDY A.I PERFORMED WELL VERSUS DERMATOLOGISTS GRADINGS IMPROVEMENTS NEEDED IN PIGMENTATION, PHOTOTYPE VI, AND YOUNGER/OLDER

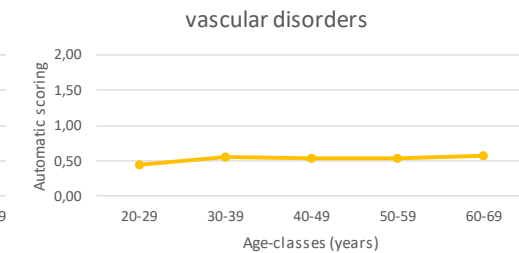
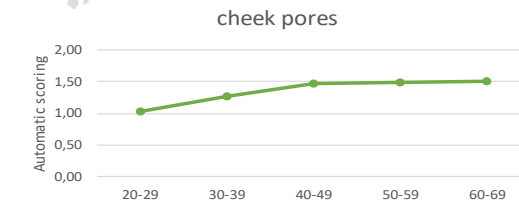
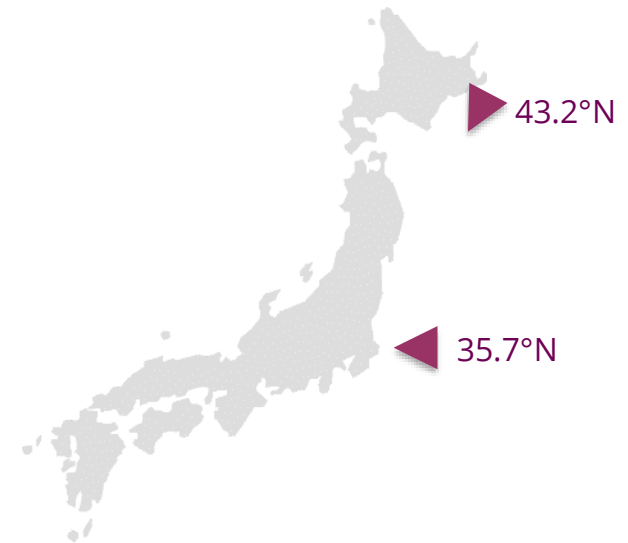
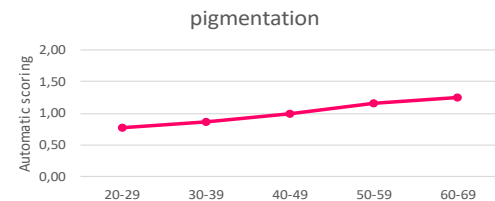
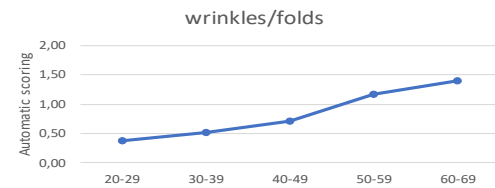
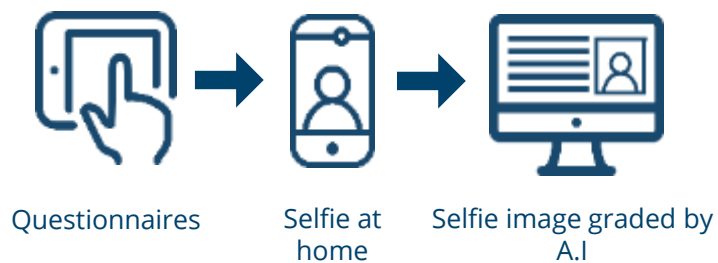


Use of an inclusive AI-based automatic grading system for knowledge purposes

# JAPANESE WOMEN FACIAL SKIN CHARACTERIZATION

Digital assessments of changes due to age

- 1,321 women (20–80y)
- Behavior towards sun exposure
- 2 cities
- 16 facial signs on selfies
- 5 clinical clusters on selfies

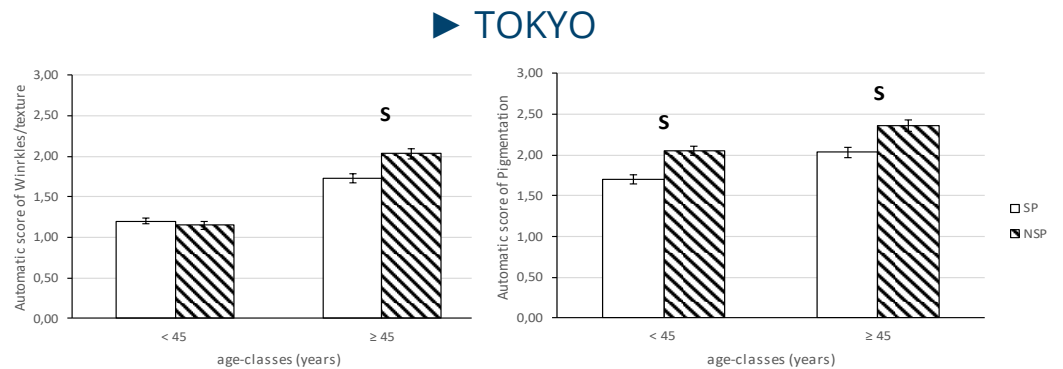
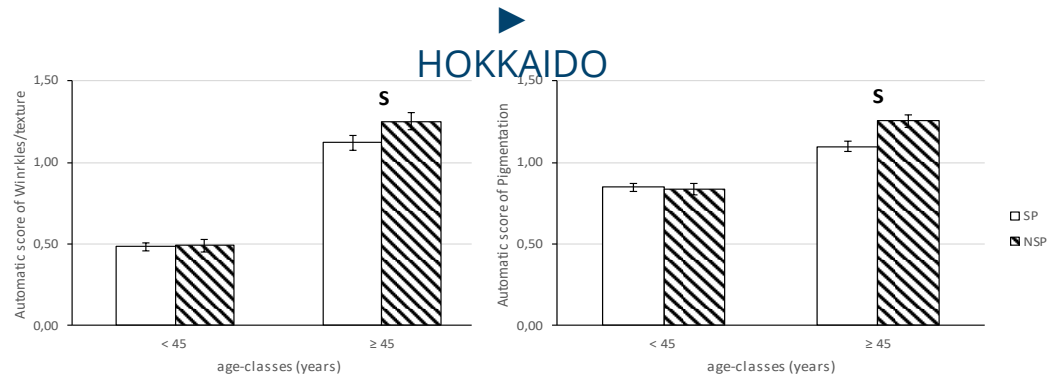
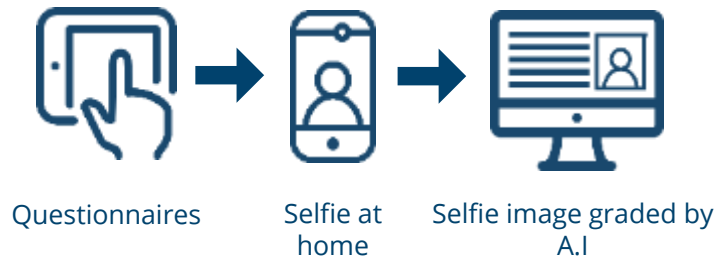


DIGITAL TYPOLOGIES: AT HOME CHARACTERIZATION OF FACIAL SKIN AGING IN JAPANESE WOMEN.

# JAPANESE WOMEN FACIAL SKIN PHOTO-AGING

Selfie images characterization of sun exposures and latitude impacts

- South: vascular & sagging higher
- North: wrinkles lower before 50y
- Photo-aging: wrinkles after 45y
- Photo-aging: latitude & pigmentation

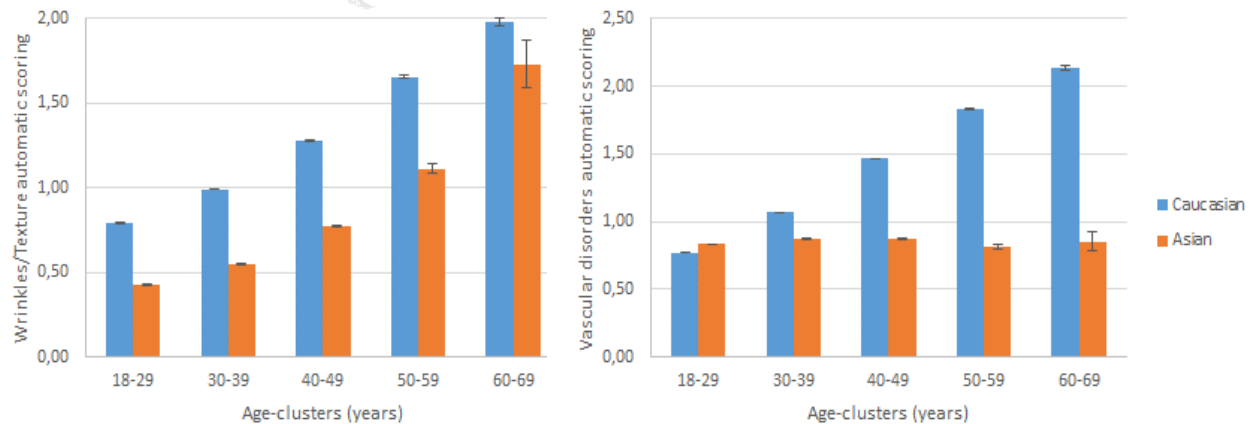
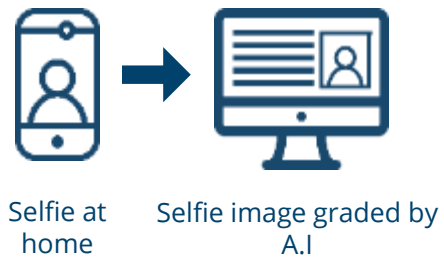
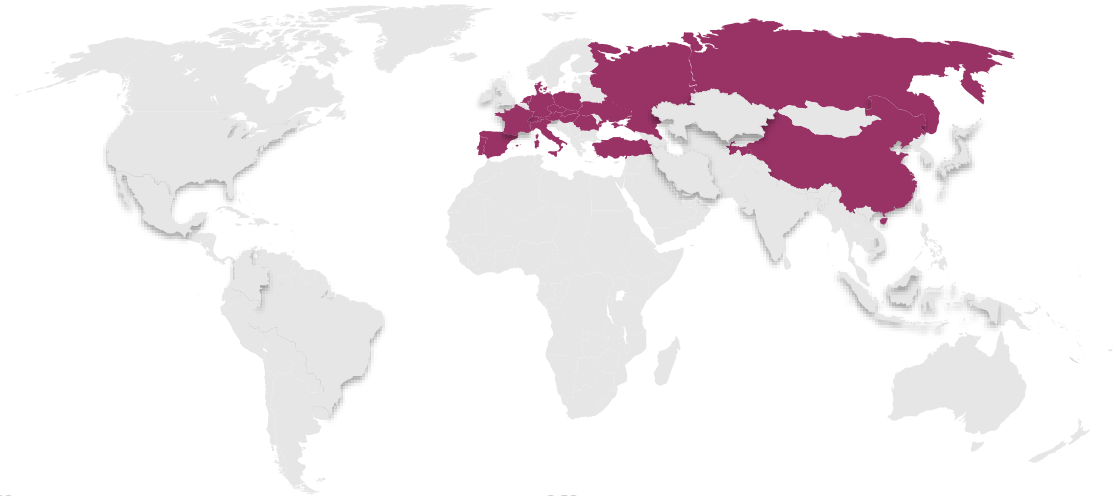


DIGITAL TYPOLOGIES: LIFESTYLES, ENVIRONMENTS AND LATITUDE IMPACT SIGNIFICANTLY JAPANESE SKIN.

# SKIN AGING PROCESS ON LARGE SCALE

More than half a million individuals with European or East-Asian origins

- 544,603 women (18–75y)
- European & East-Asian cohorts
- 5 clinical clusters on selfies
- Specificities in skin aging



**DIGITAL EPIDEMIOLOGY: QUANTIFICATION OF FACIAL SIGNS WITH AGES, ENVIRONMENTS AND LIFESTYLES.**



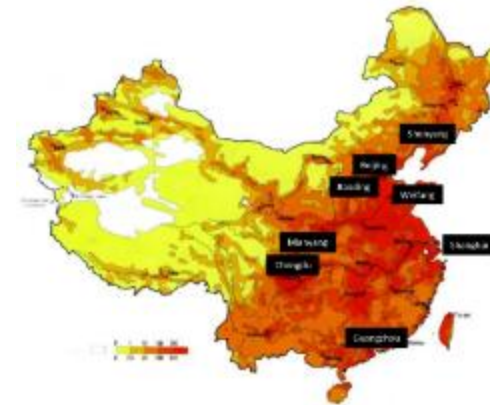


Use of an inclusive AI-based automatic grading system to assess performance

# QUANTIFY EFFICACY AFTER ONE MONTH APPLICATION

Digital consumer/clinical study on one thousand Chinese women

- 1,064 women (20–60y)
- 8 cities across China
- 16 facial signs on selfies
- Self-assessments
- Virtual clinical sub-cohorts



DIGITAL EFFICACY STUDIES: REAL USERS IN REAL LIFE FOR MORE SINCERE & INNOVATIVE CLAIMS.



Scientific support and endorsement of an  
inclusive AI-based automatic grading system



# NEXT STEPS FOR AUTOMATIC GRADING

TO A MORE HOLLISTIC AND ACCURATE AUTOMATIC GRADING SYSTEM

1

MORE FACIAL SIGNS FOR CONSUMER INCLUDING ACNE

2

ENRICH FOR MORE DIVERITY (GENDER...)

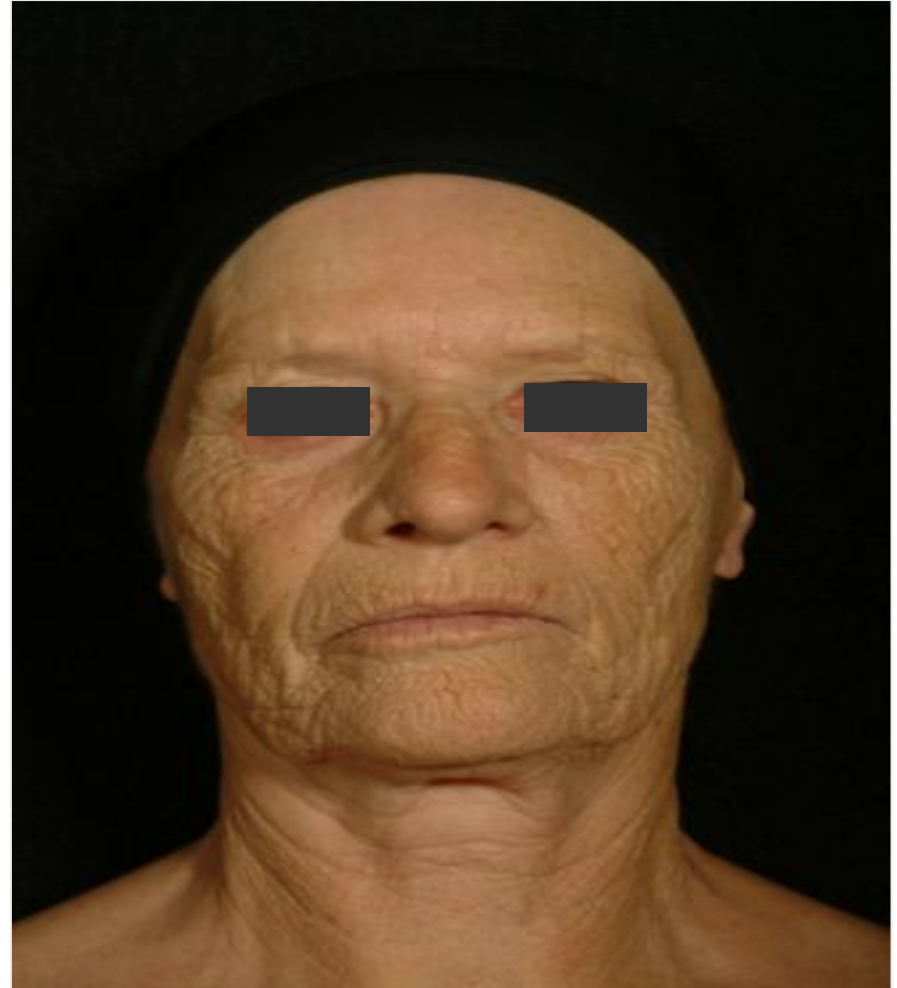
3

LARGER COHORTS STUDIED



Perceived apparent age and impact of  
exposome

# APPEARANCE



Same age: 67 y.o.

# AGEING, ANCESTRIES & CULTURE





# EXPOSOME, EXAMPLE SEASON

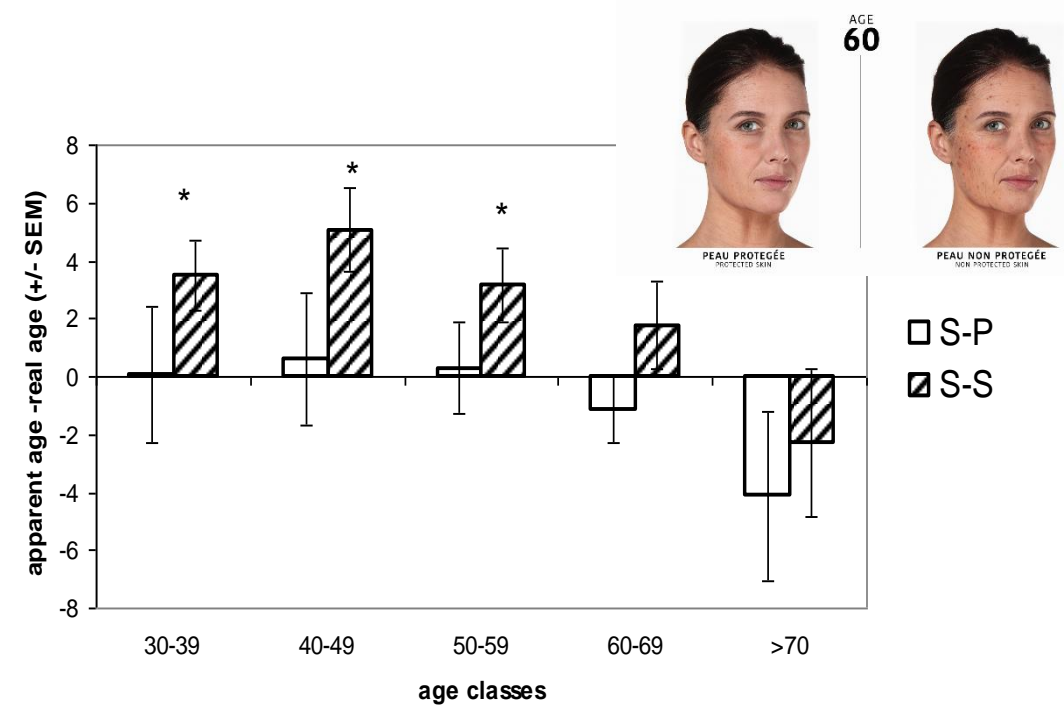


Decode in each country/culture perceived  
apparent age with facial clinical signs

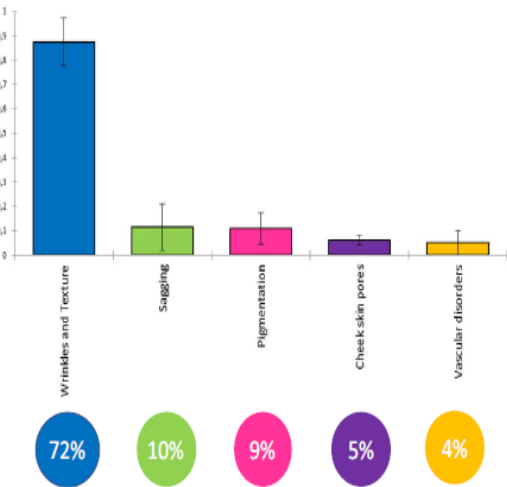
# DECODE CONSUMER PERCEPTION

## Appreciation by consumer of apparent ages

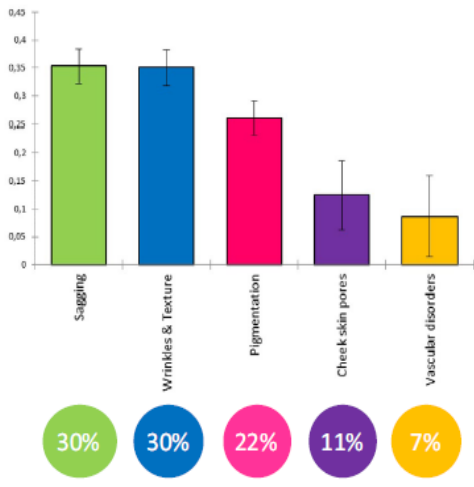
- 7 countries
- Pictures of Men & women, aged 20-80 yo
- Annotations by 15 dermatologists
- 100 women by country, aged 20-60 yo
- Perceived age in years
- Other appreciations: Radiance, Tiredness



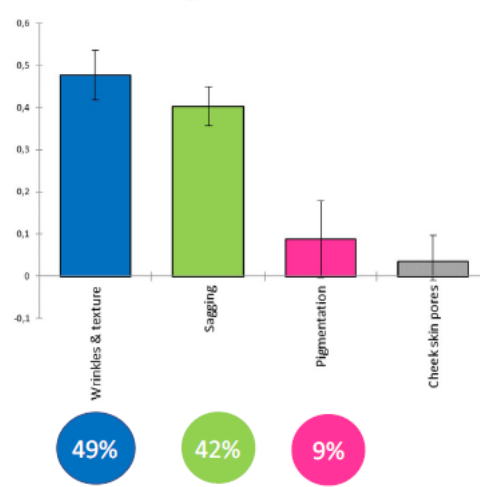
# HOLISTIC PERCEIVED APPARENT AGE (WOMEN)



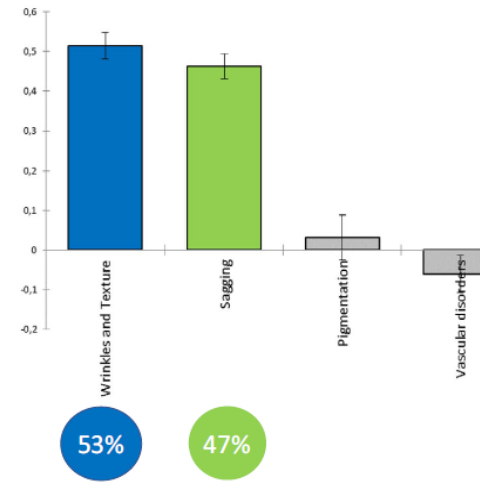
CHINA



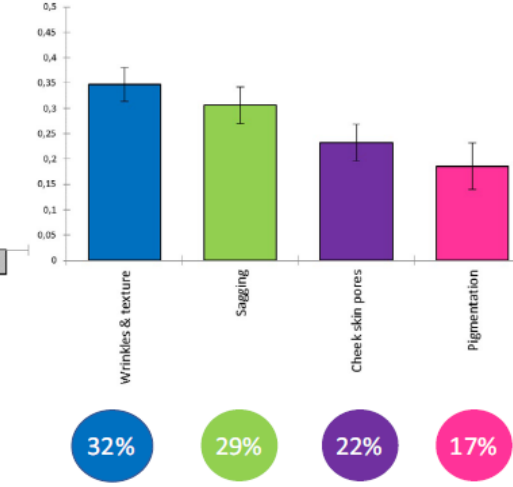
JAPAN



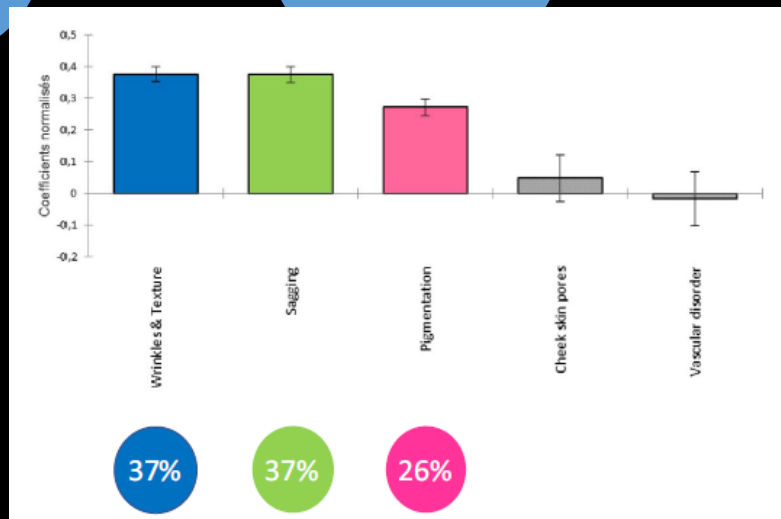
INDIA



FRANCE



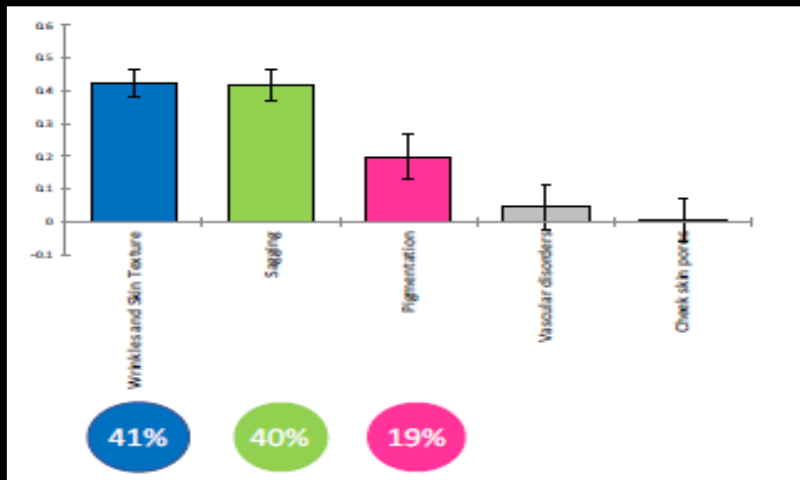
SOUTH AFRICA



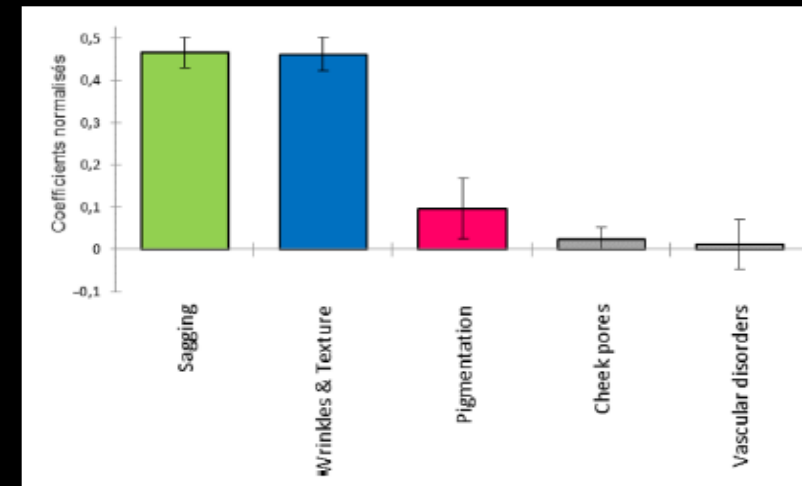
KOREA

# HOLISTIC PERCEIVED APPARENT AGE

PREDICT & DECODE CONSUMER PERCEPTION FOR MEN



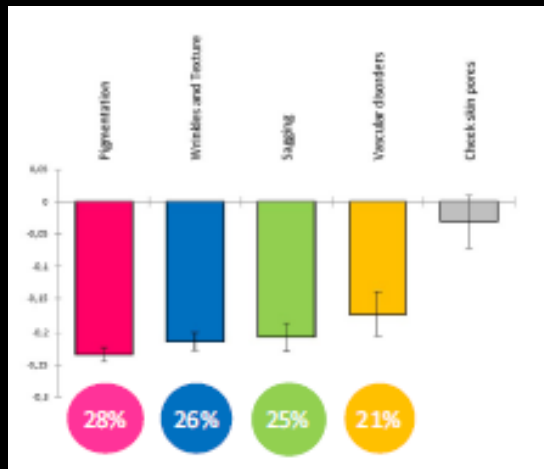
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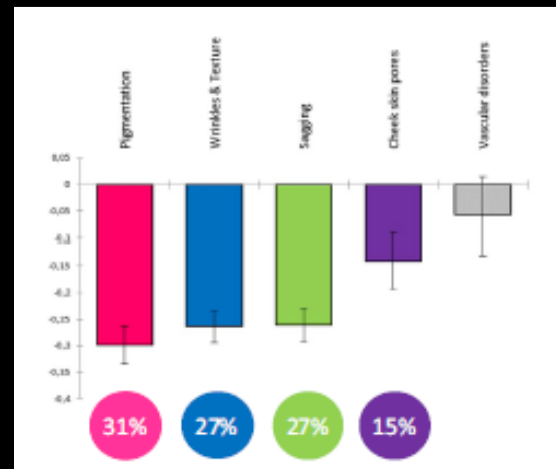
CHINA

# HOLISTIC PERCEIVED RADIANCE

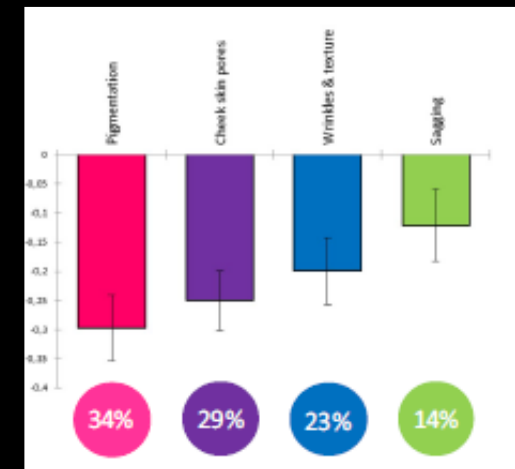
PREDICT & DECODE CONSUMER PERCEPTION



CHINA



JAPAN



SOUTH AFRICA

# TO A NEW PERSONNALIZATION

PROVIDE ACCURATE DIAGNOSTIC AND HOLISTIC ASSESSMENT TO CONSUMERS

1

ADDITION OF NEW FACIAL FEATURES ► 40 FACIAL SIGNS

2

COLLECT MORE CULTURES (MEXICO, INDONESIA...)

3

RESEARCH API