



THE ECO WELL PRESENT

The Hair Science E-Summit

Sept 24th, 2023

Texturized Curly Hair

Crystal Porter, Ph.D.

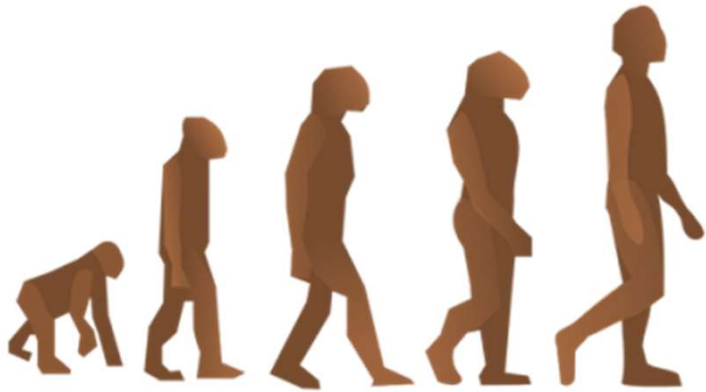
Mane Insights, Inc., President

Association of Professional Trichologists,
Executive Director

Overview

- Origin of Curl
- History of Curl Typing
- Textured Hair Needs
- Implications of Grooming Hair
- The Negatives of Moisture
- Takeaways
- What You Can Do
- Q&A

Origin of Curl

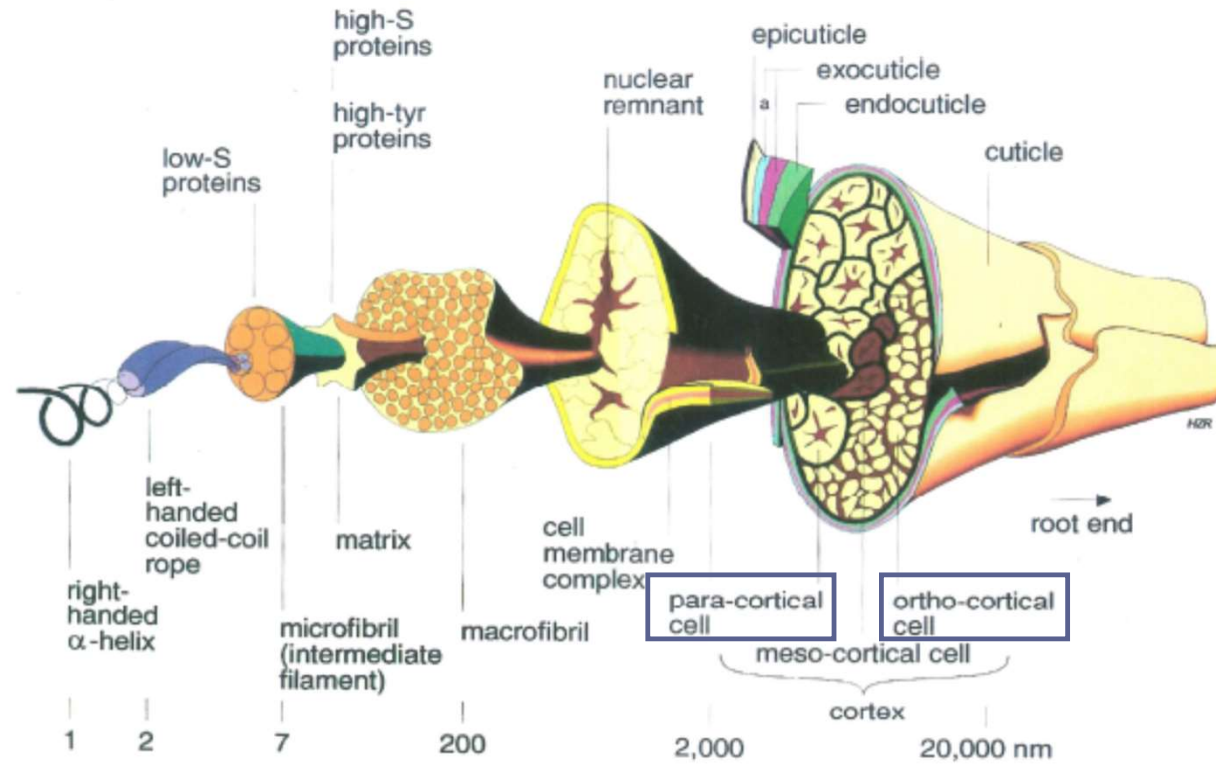


Hrdy, D. Quantitative hair form variation in seven populations. *Am. J. Phys. Anthropol.* **39**, 7–17 (1973)



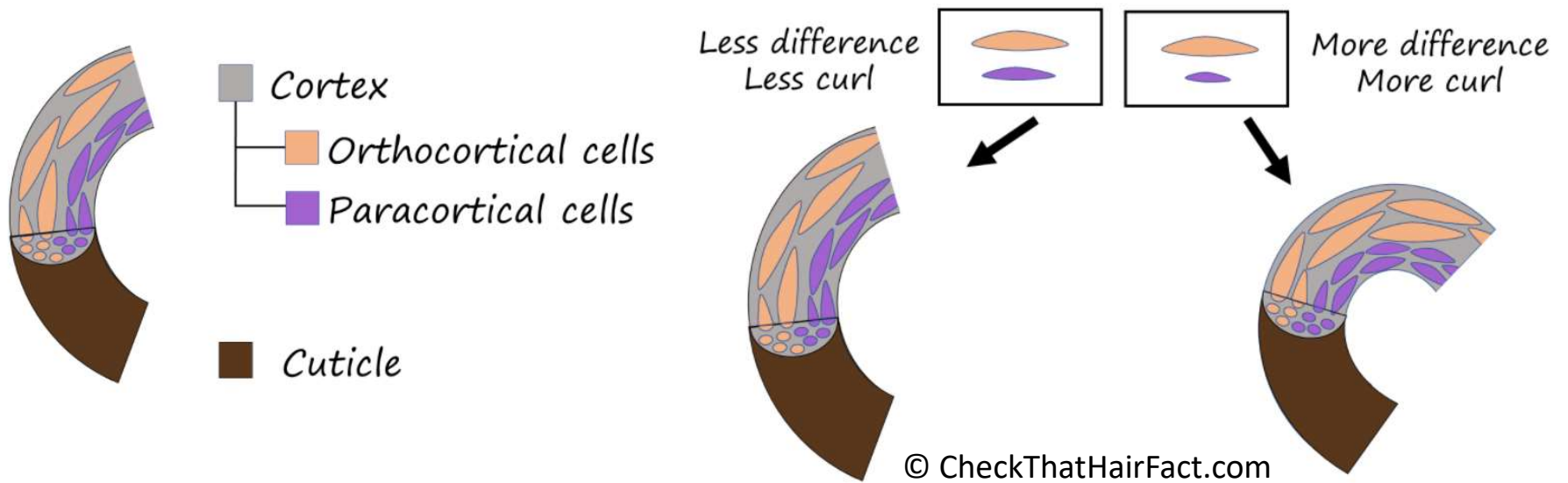
Lasisi, T., Zaidi, A.A., Webster, T.H. *et al.* High-throughput phenotyping methods for quantifying hair fiber morphology. *Sci Rep* **11**, 11535 (2021)

Structure of Hair



Feughelman 1997 adapted from Fraser 1981

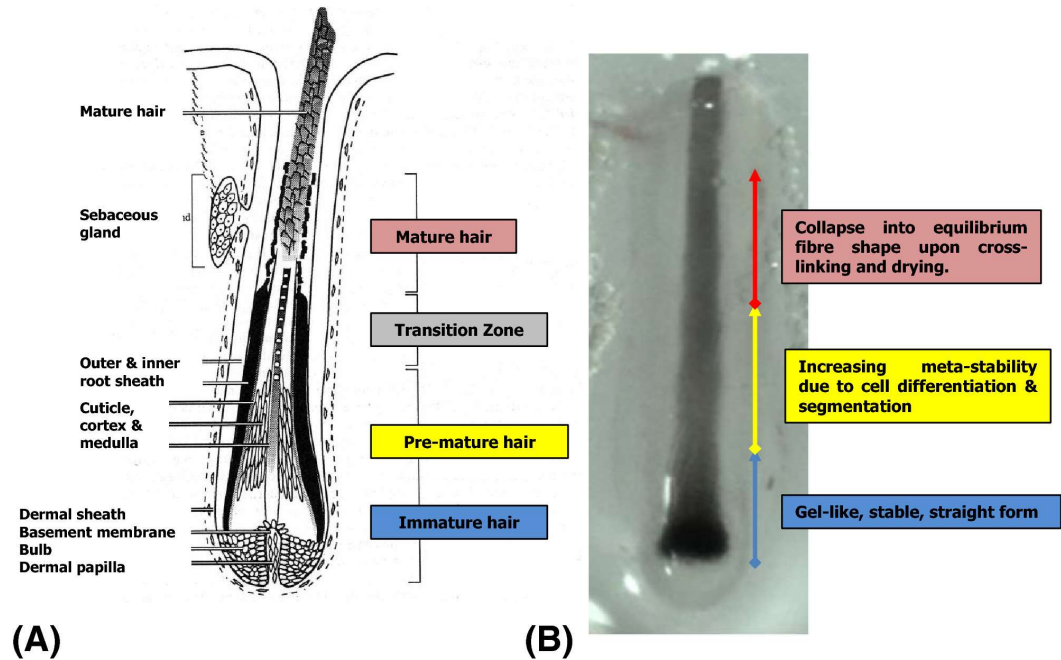
Curl in Hair: Distribution of Para and Ortho Cortical Cells



<https://checkthathairfact.com/cortex/why-hair-curls/>

Harland, DP et al. Journal of Experimental Biology (2018) 221 Intrinsic curvature in wool fibres is determined by the relative length of orthocortical and paracortical cells

Hair Shape is Programmed within the Bulb



S Thibaut, O Gaillard, P Bouhanna, DW Cannell, BA Bernard (2005) Human hair shape is programmed from the bulb, *Brit J Derm* **152** 632-638

Wortmann, FJ, Wortmann, G, Sripho, T. Why is hair curly?—Deductions from the structure and the biomechanics of the mature hair shaft. *Exp Dermatol.* 2020; 29: 366 – 372

Curl in Hair: The Role of Trichohyalin

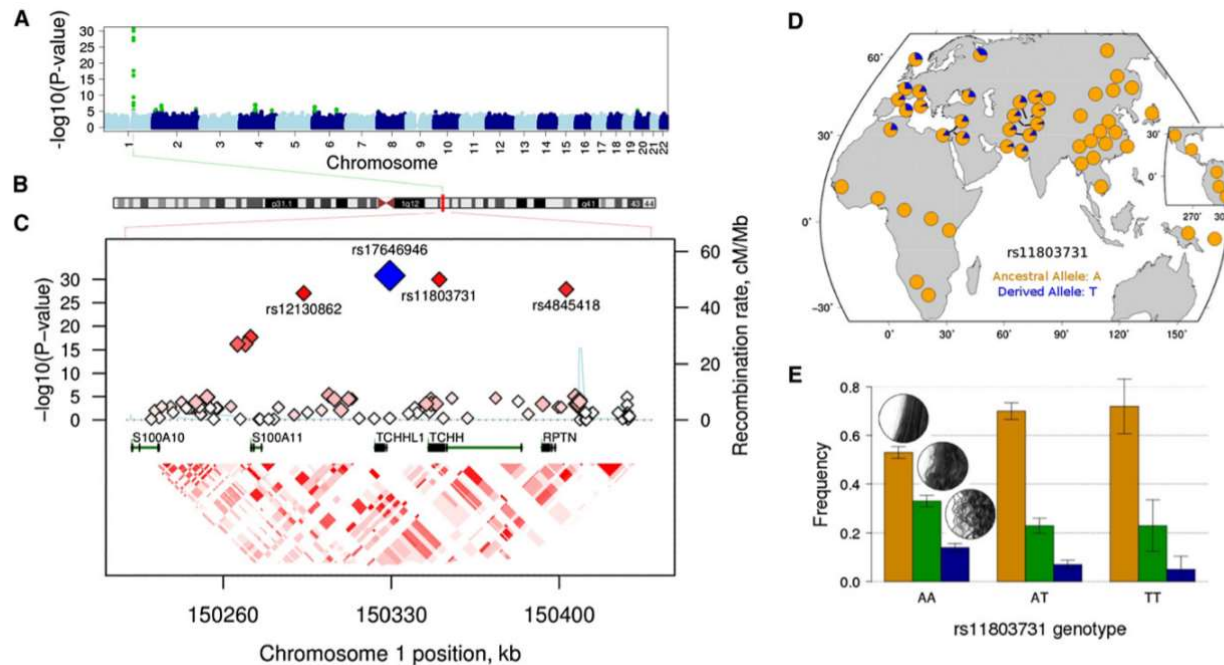
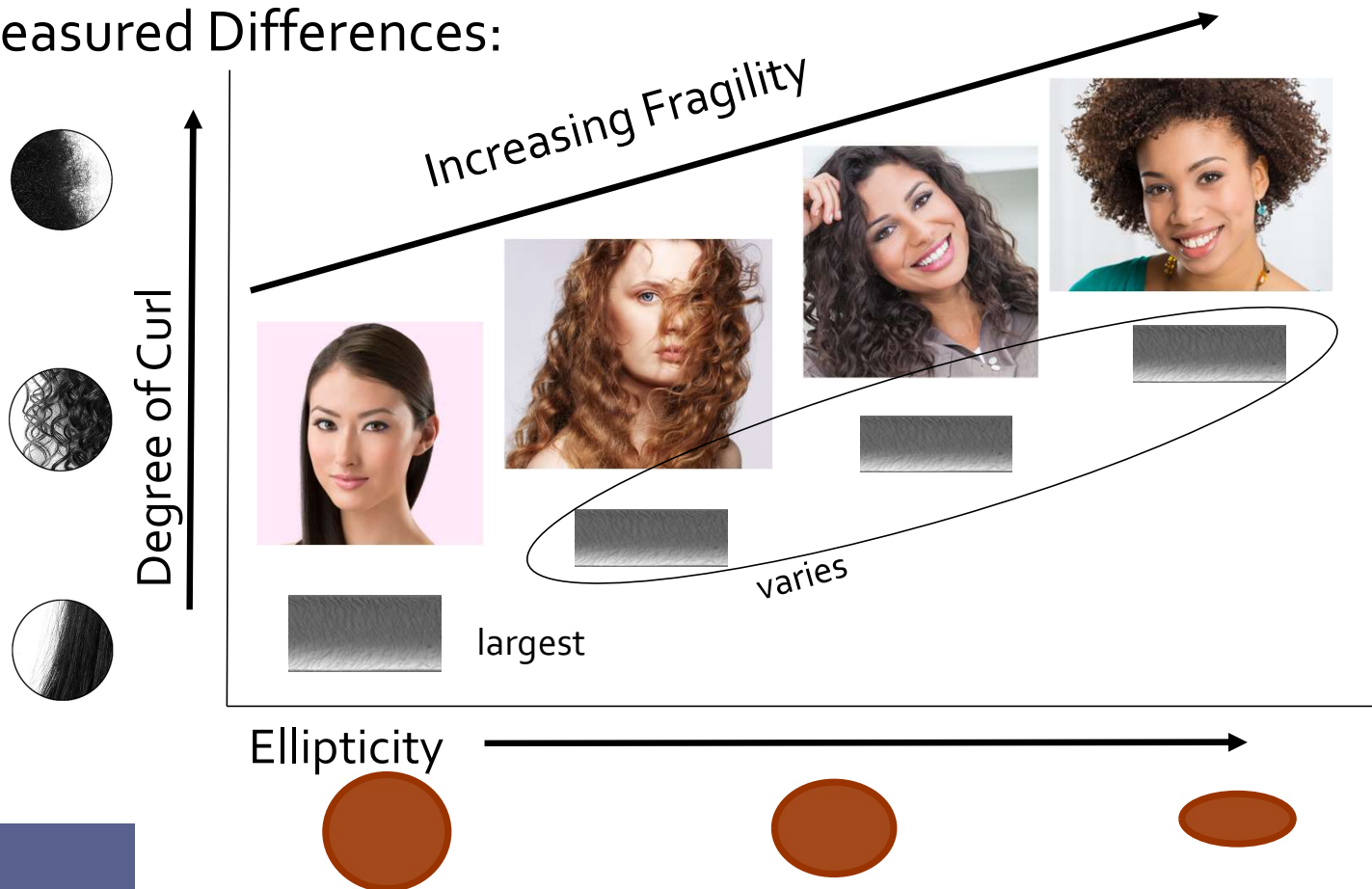


Figure 1. Genome-wide Association Results

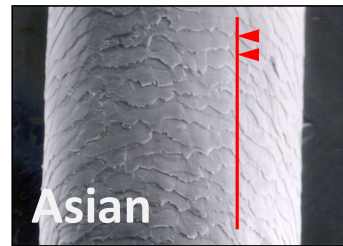
Sarah E. Medland et al. (2009) Common Variants in the Trichohyalin Gene Are Associated with Straight Hair in Europeans, *Amer. J. Human Genetics* 85, (5) 750–755

Common Knowledge About Interethnic Hair Characteristics

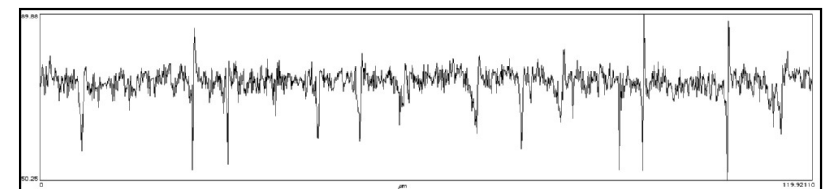
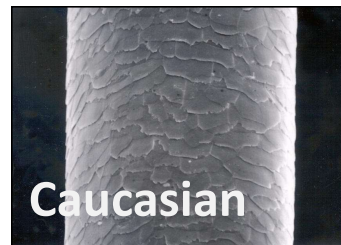
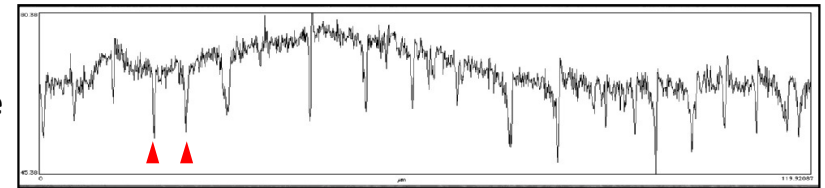
Measured Differences:



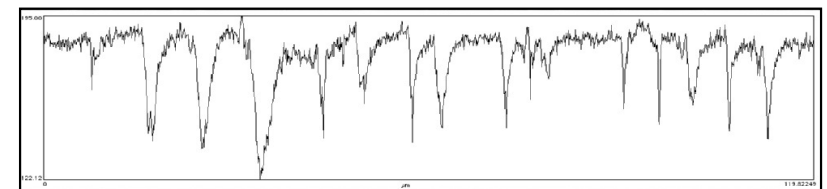
Cuticle Layers and Spacing Differ



More Cuticle Layers



Less Cuticle Layers



Bryant, H., Porter, C.E. (2012). Hair Ethnicity. T. Evans and R.R. Wickett (Ed.). *Practical Modern Hair Science* (pp. 215). Carol Stream, IL: Allured Business Media

There are Differences in Hair Growth

	African (n=216)	Asian (n=188)	Caucasian (n=107)
Hair Growth Rate ($\mu\text{m}/\text{day}$)	$280 \pm 50^*$	$411 \pm 53^*$	$367 \pm 56^*$
Hair Density (fibers/ cm^2)	161 ± 50	175 ± 54	$226 \pm 73^*$

Our Variety of Curls are Uniquely Expressed



MANE
INSIGHTS

Hair Descriptors

COILY

STRAIGHT

KINKY

WIRY

TEXTURED

NAPPY

CURLY

WAVY

ZIG-ZAGGED

2018 Texture Trends Report

NATURALLY *Curly*

65% of Women Say they Have Textured Hair

80% of Women Buy Products Marketed for Textured Hair

Spending is 78% More Than Straight Hair Consumers

More than 50% of Consumers Buy Products 1x/month

Those with Curly/Coily Hair Buy Products 2x/month



Curl Typing: Andre Walker



ANDRE WALKER
HAIR TYPING SYSTEM

<p>TYPE 1</p> <p>STRAIGHT HAIR</p> <p>FINE & FRAGILE TO COARSE & THIN (CURL RESISTANT)</p>	<p>A</p> <p>B</p> <p>C</p>	<p>TYPE 1 PRODUCTS</p> <ul style="list-style-type: none"> • ULTIMATE MOISTURE SHAMPOO • TKO CONDITIONER • GET IT STRAIGHT • O-OIL
<p>TYPE 2</p> <p>WAVY HAIR</p> <p>FINE & THIN TO COARSE & FRIZZY</p>	<p>A</p> <p>B</p> <p>C</p>	<p>TYPE 2 PRODUCTS</p> <ul style="list-style-type: none"> • ULTIMATE MOISTURE SHAMPOO • TKO CONDITIONER • BEAUTIFUL CURLS • GET IT STRAIGHT • O-OIL
<p>TYPE 3</p> <p>CURLY HAIR</p> <p>LOOSE CURLS TO CORKSCREW CURLS</p>	<p>A</p> <p>B</p>	<p>TYPE 3 PRODUCTS</p> <ul style="list-style-type: none"> • ULTIMATE MOISTURE SHAMPOO • TKO CONDITIONER 3A: BEAUTIFUL CURLS 3B: BEAUTIFUL KINKS • GET IT STRAIGHT • O-OIL
<p>TYPE 4</p> <p>KINKY HAIR</p> <p>TIGHT COILS TO Z-ANGLED COILS</p>	<p>A</p> <p>B</p>	<p>TYPE 4 PRODUCTS</p> <ul style="list-style-type: none"> • ULTIMATE MOISTURE SHAMPOO • TKO CONDITIONER • BEAUTIFUL KINKS • GET IT STRAIGHT • O-OIL

Curl Typing Modification

TYPE 2 WAVY HAIR

NATURALLYCurly



2A

2B

2C

Type 2: Wavy Hair



TYPE 2 CURLS



2A: Soft Wave



2B: Wavy



2C: Deep Wave

<https://www.naturallycurly.com/curlreading/learn/curlly-hair-guide-whats-your-curl-pattern-hi>

<https://www.goodhousekeeping.com/beauty/hair/a32733411/curl-hair-types/>

Curl Typing Modification, Continued

TYPE 3 CURLY HAIR

NATURALLYCurly

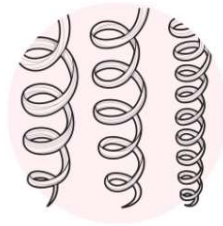


3A

3B

3C

Type 3: Curly Hair



TYPE 3 CURLS



3A: Soft Curl



3B: Curly



3C: Ultra Curly

<https://www.naturallycurly.com/curlreading/learn/curly-hair-guide-whats-your-curl-pattern-hi>

<https://www.goodhousekeeping.com/beauty/hair/a32733411/curl-hair-types/>

Curl Typing Modification, Continued

TYPE 4 COILY HAIR

NATURALLYCurly



4A

4B

4C

Type 4: Coily/Kinky Hair



TYPE 4 CURLS



4A: Coiled



4B: Zig-Zag



4C: Tightly Coiled

<https://www.naturallycurly.com/curlreading/learn/curly-hair-guide-whats-your-curl-pattern-hi>

<https://www.goodhousekeeping.com/beauty/hair/a32733411/curl-hair-types/>

L'Oréal Worldwide Hair Classification

Quantification of the curl in hair:

- Based on objective measurements
- Doesn't refer to racial heritage

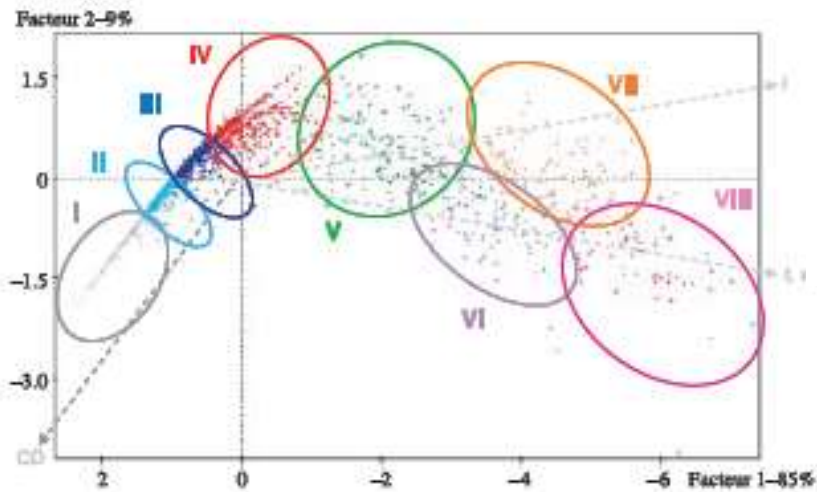
Rolland de la Mettrie *et al*, Human Biology June 2007, 79 (3), 265

Over 2400 people studied

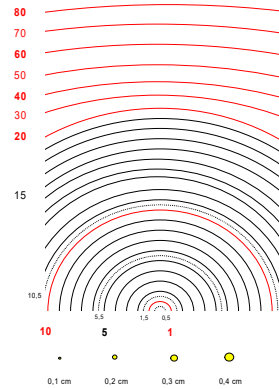


Curl Differentiation

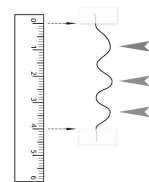
Data Processing



Principal Component Analysis
&
Hierarchical Ascendant
Classification

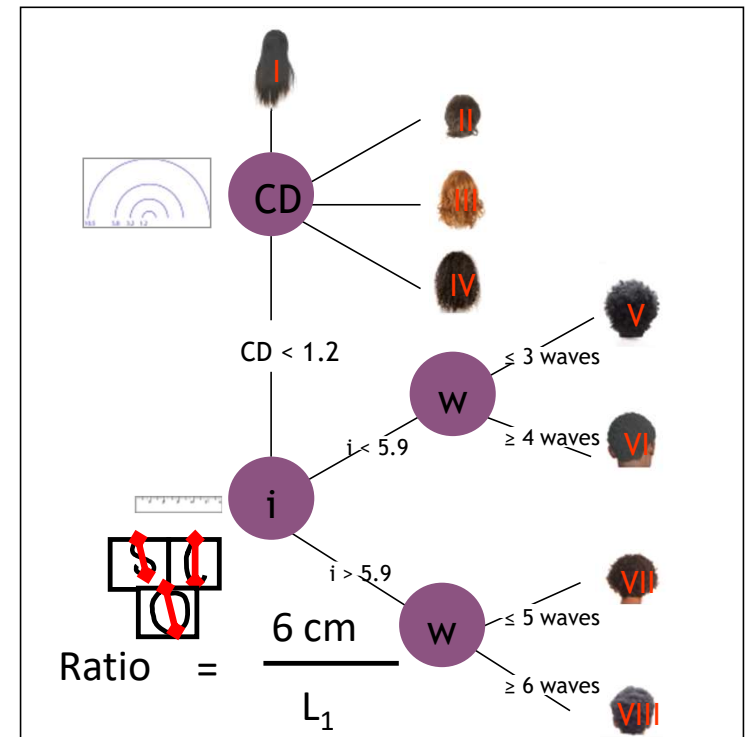


CD: measure of
the smallest
curve diameter



Waves

Segmentation Tree



L_1 : distance between the two furthest points

Worldwide Classification



I



II



III



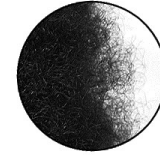
IV



V



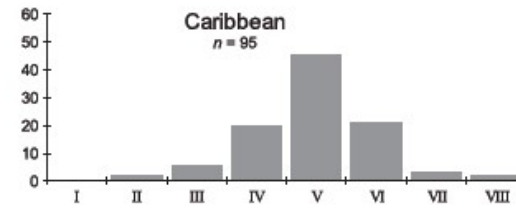
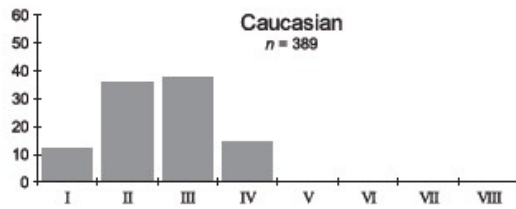
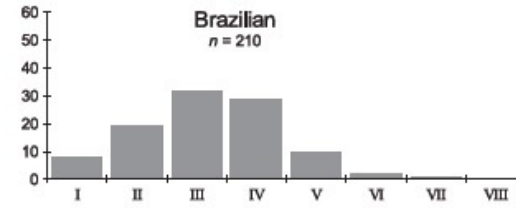
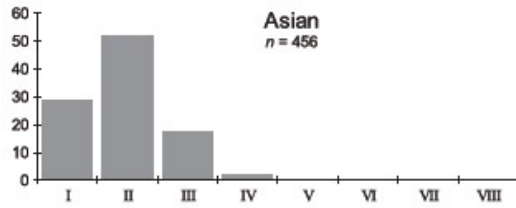
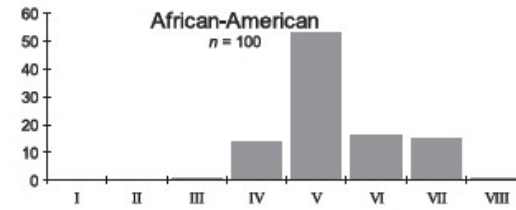
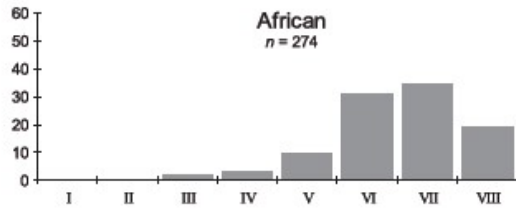
VI



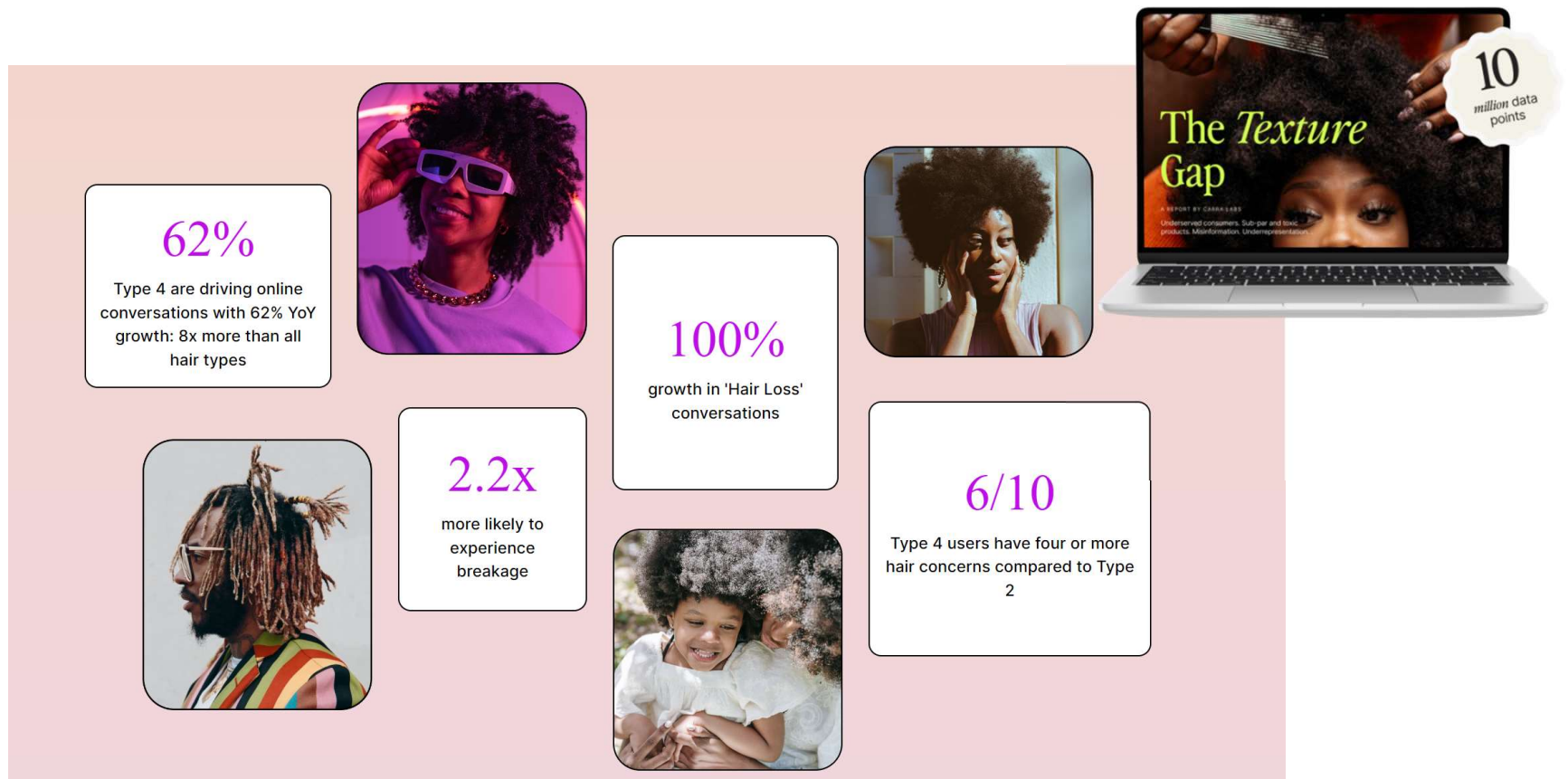
VII



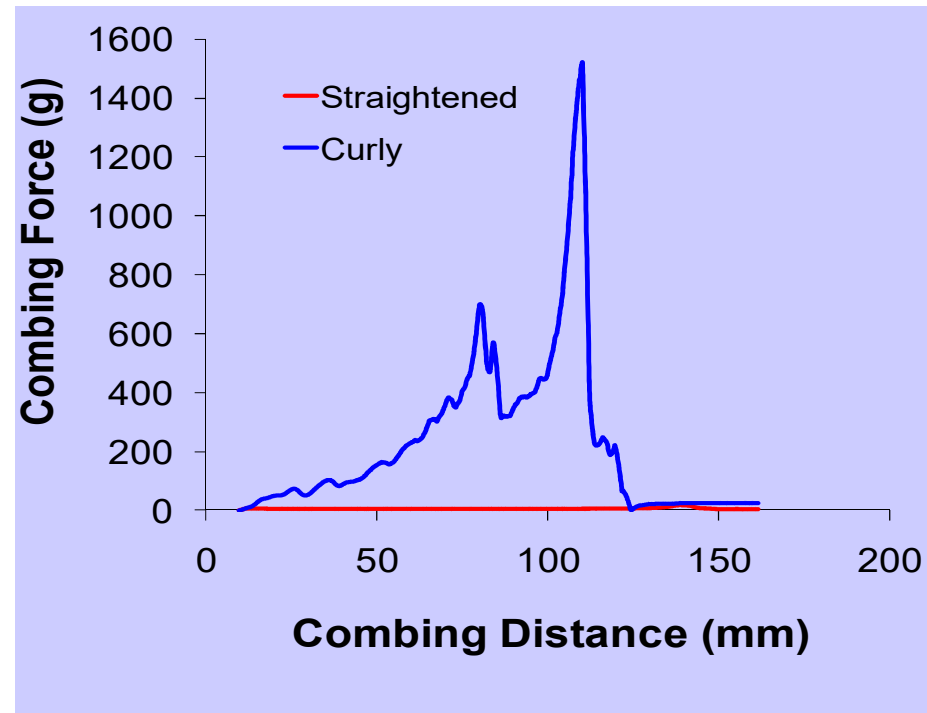
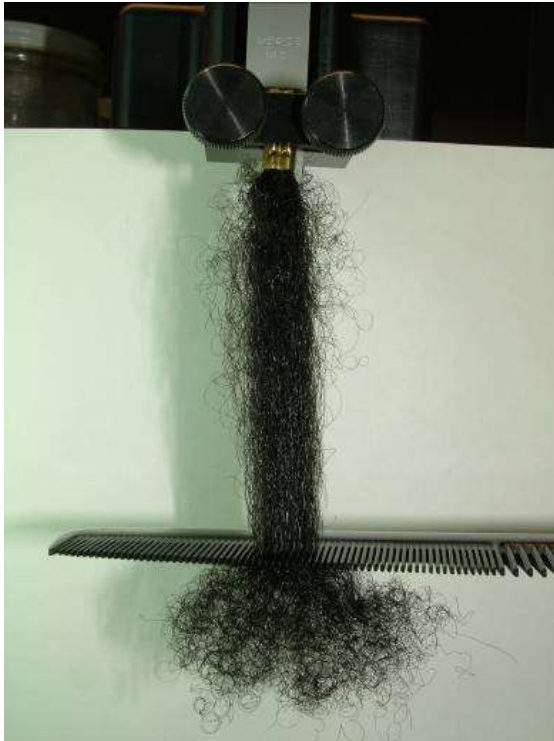
VIII



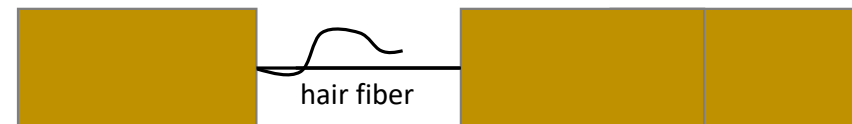
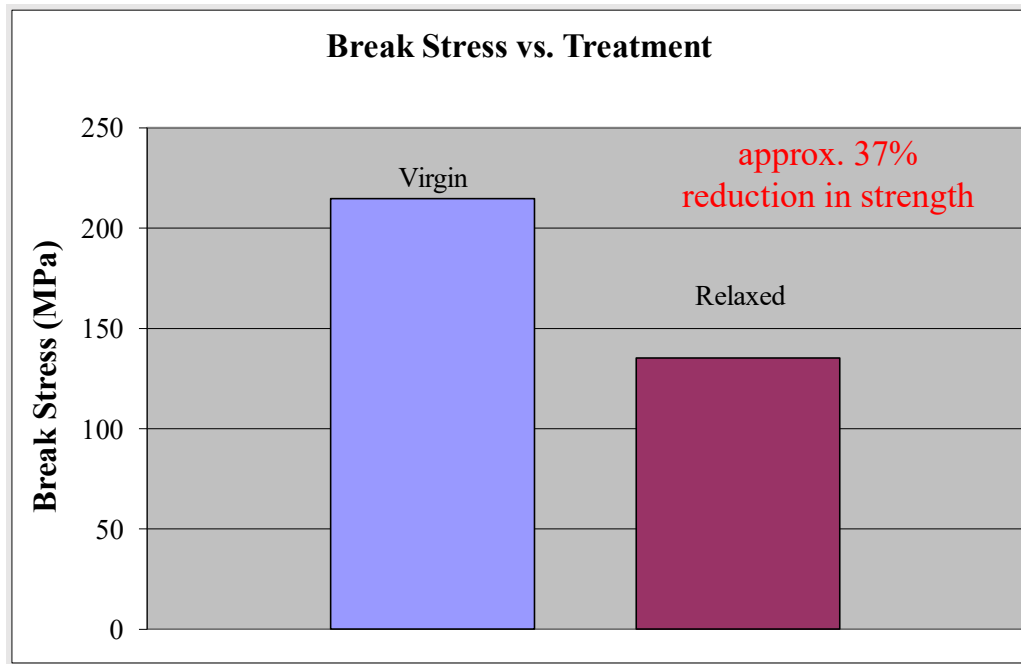
Those with the Tightest Curls Have More Needs



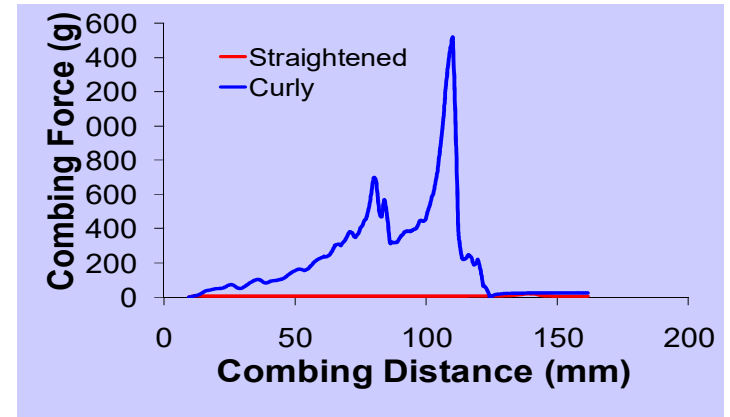
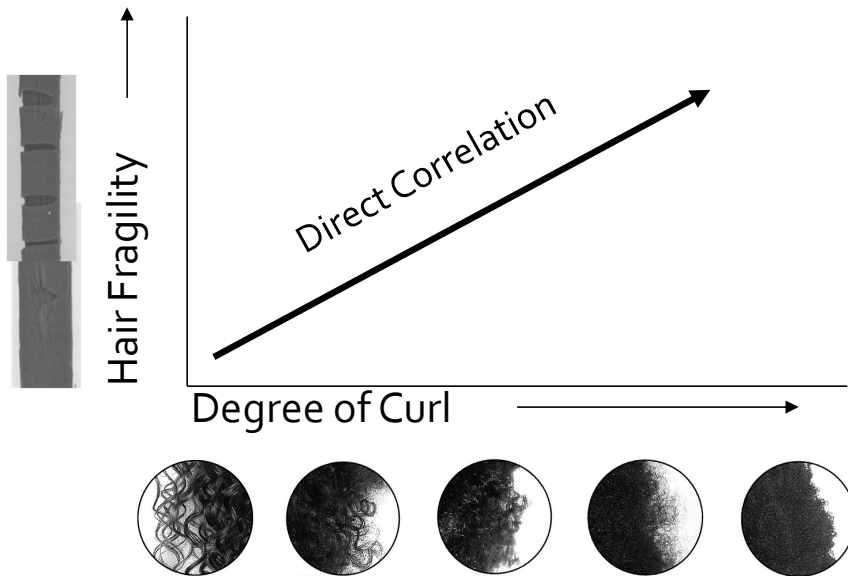
It's Easier to Comb Straightened Hair



Relaxer Usage Weaken the Hair

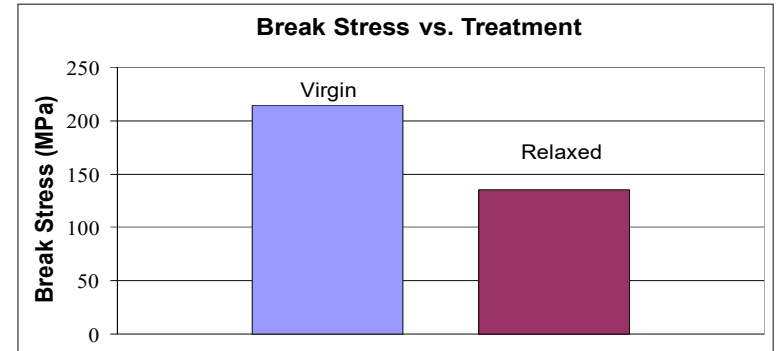


Curly Hair Paradox #1



C. Porter et al. *International Journal of Dermatology*, 2005, 44 (Suppl. 1) 4-5

Is it better to have stronger hair that is more difficult to manage or weaker hair that is easier to comb?



Manual Combing Experiment



4 teeth/cm

Swatches = 250 mg; 100 combing passes
7 cm length

Virgin

1.25 passes/sec

Max of 14 teeth

Relaxed

1.55 passes/sec

Max of 8 teeth

Oil

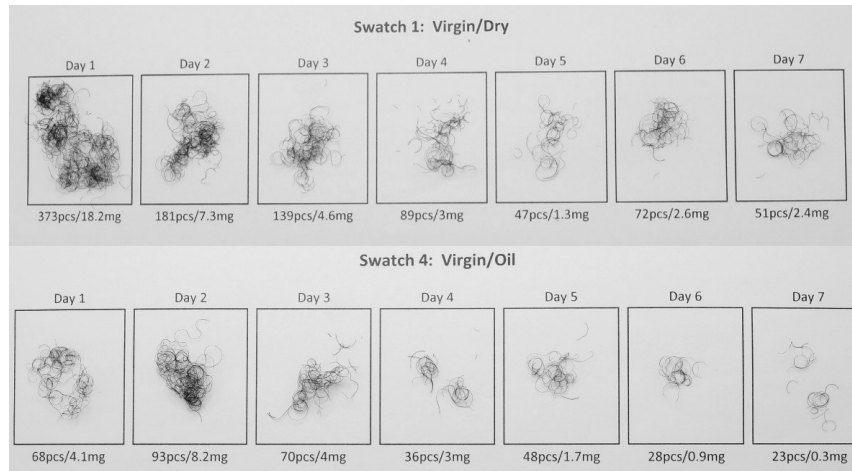
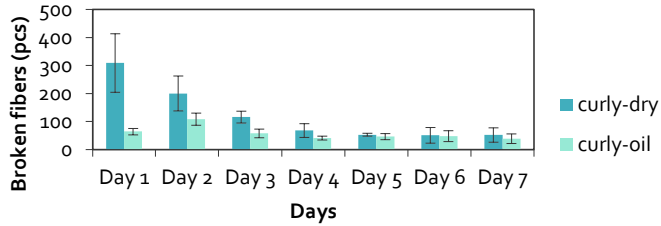
0.08 g

0.05 g

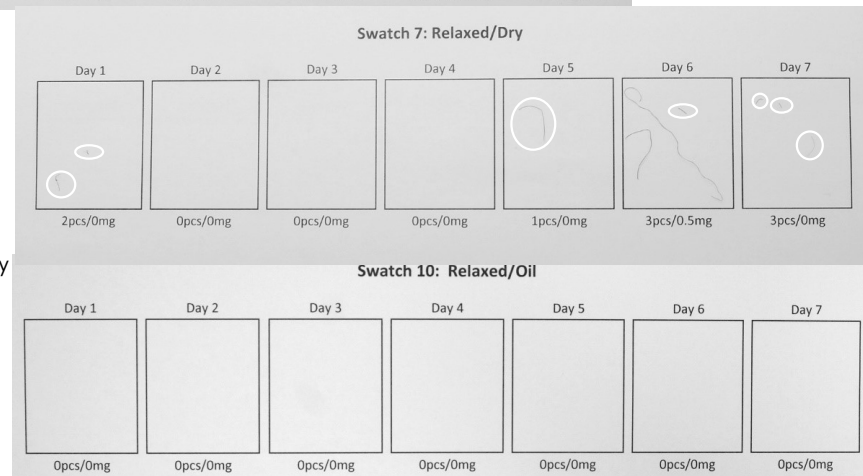
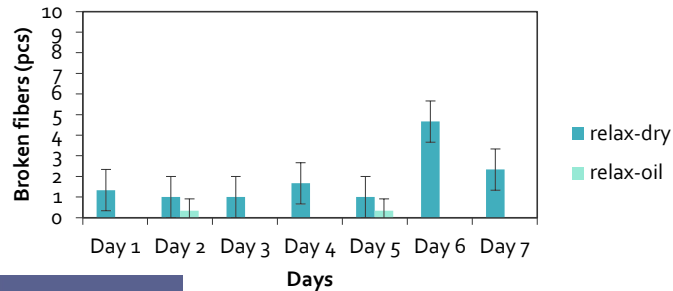
Curlier Hair Can Break More than Relaxed Hair

Bryant, H. and Porter, C.E. (2013, Aug). Hair Ethnicity, in Practical Modern Hair Science. Evans, T.A. and Wickett, R.R. *Allured Books*.

Untreated Curly Hair Broken Fibers



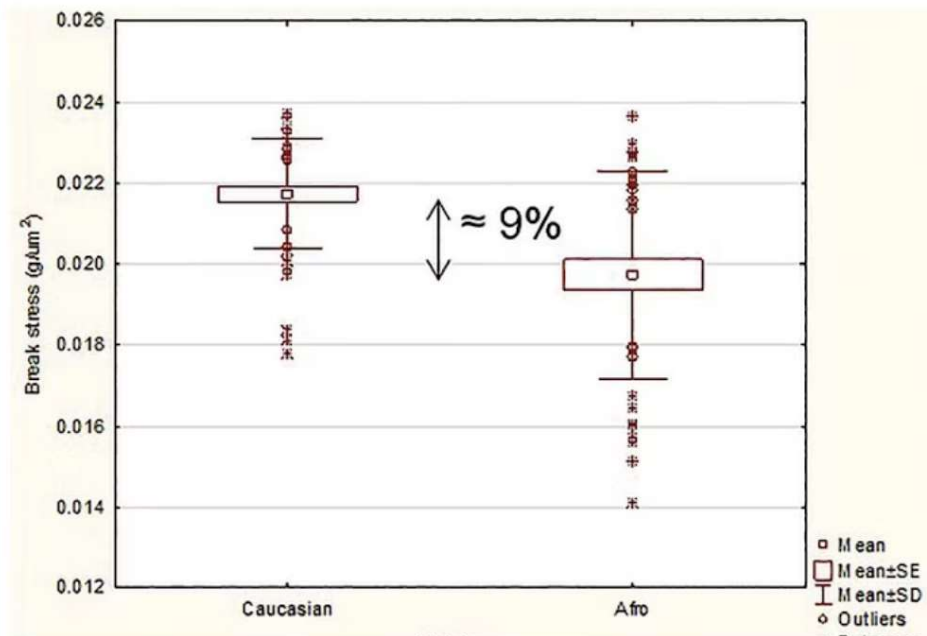
Relaxed Hair Broken Fibers



Hair of African Descent is Weaker than Caucasian Hair

Figure 1. Break stress at 60% RH

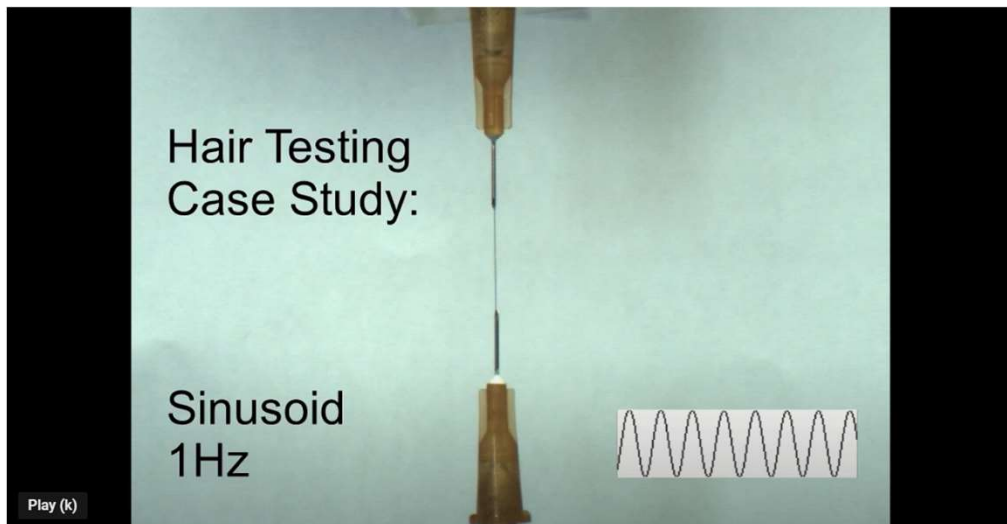
Break stress for virgin Caucasian and Afro hair at 60% RH



[CLICK TO VIEW FIGURE](#)

Evans, T. (2020) Beyond Biology: Why African hair is fragile
Cosm Toil **135**, 6, 38 - 45

Relaxed Hair Can Endure with Lower Manipulation Forces



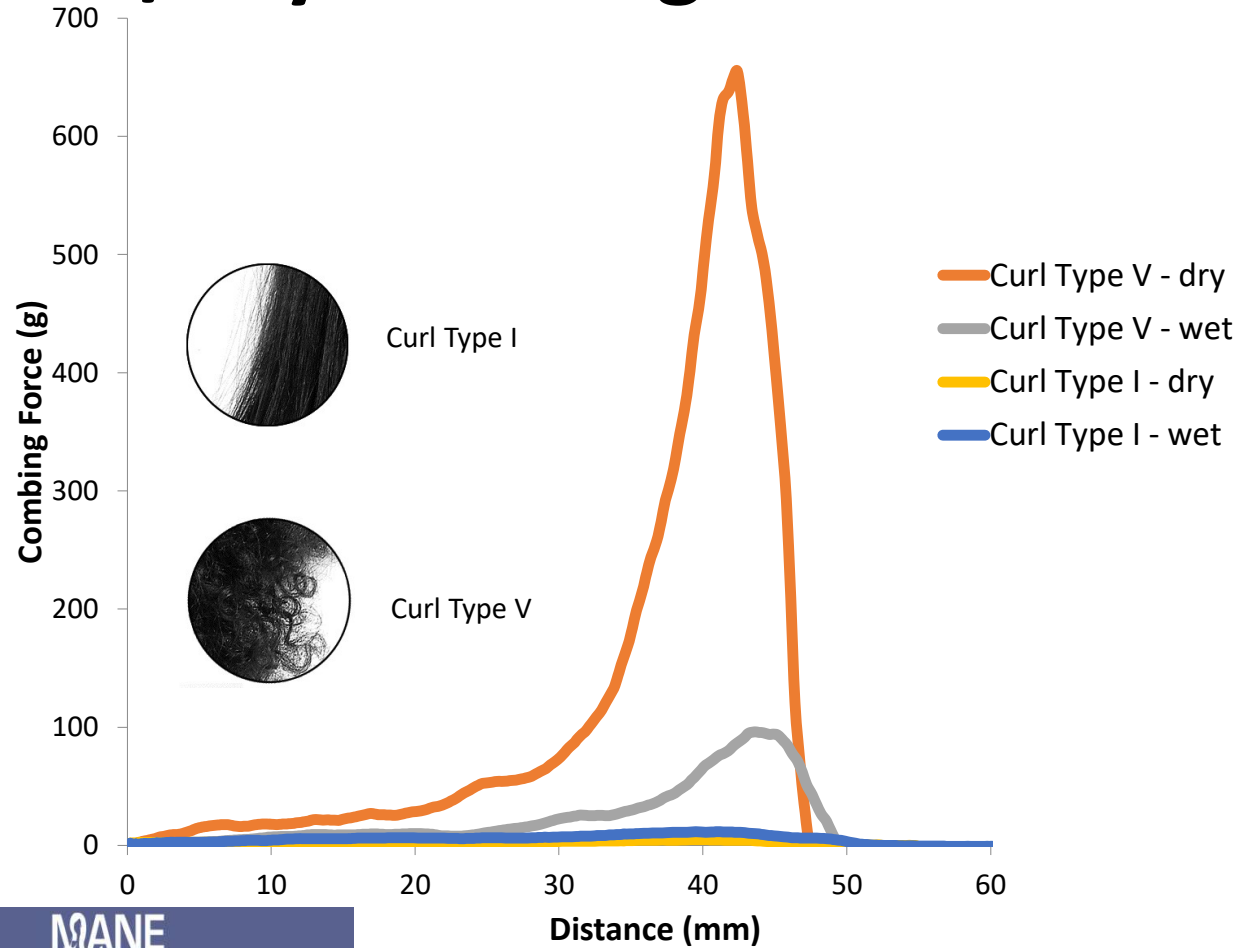
<https://www.youtube.com/watch?v=FV2mnoDzKec>

Modeling scenario	Cycles-to-fail
Virgin Caucasian hair—0.010 g/μm ² stress	37,000
Virgin African hair—0.010 g/μm ² stress	5,500
Virgin African hair—0.011 g/μm ² stress (i.e., a 10% increase in grooming stress)	1,930
Virgin African hair—0.012 g/μm ² stress (20% increase)	650
Virgin African hair—0.013 g/μm ² stress (30% increase)	220
Virgin African hair—0.014 g/μm ² stress (i.e., a 40% reduction in grooming stress)	74
Virgin African hair—0.015 g/μm ² stress (50% reduction)	25

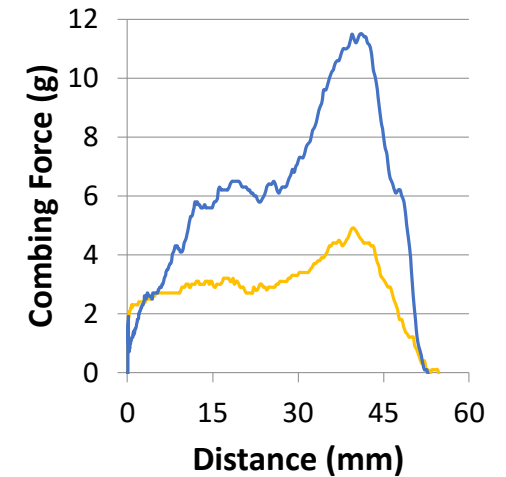
Modeling scenario	Cycles-to-fail
Virgin Caucasian hair—0.010 g/μm ² stress	37,000
Virgin African hair—0.010 g/μm ² stress	5,500
Relaxed African hair—0.010 g/μm ² stress	140
Relaxed African hair—0.008 g/μm ² stress (i.e., a 20% reduction in grooming stress)	1,300
Relaxed African hair—0.007 g/μm ² stress (30% reduction)	3,900
Relaxed African hair—0.006 g/μm ² stress (40% reduction)	11,900
Relaxed African hair—0.005 g/μm ² stress (50% reduction)	36,200

Evans, T. (2020) Beyond Biology: Why African hair is fragile *Cosm Toil* **135**, 6, 38 - 45

Wet/Dry Combing Forces Differ

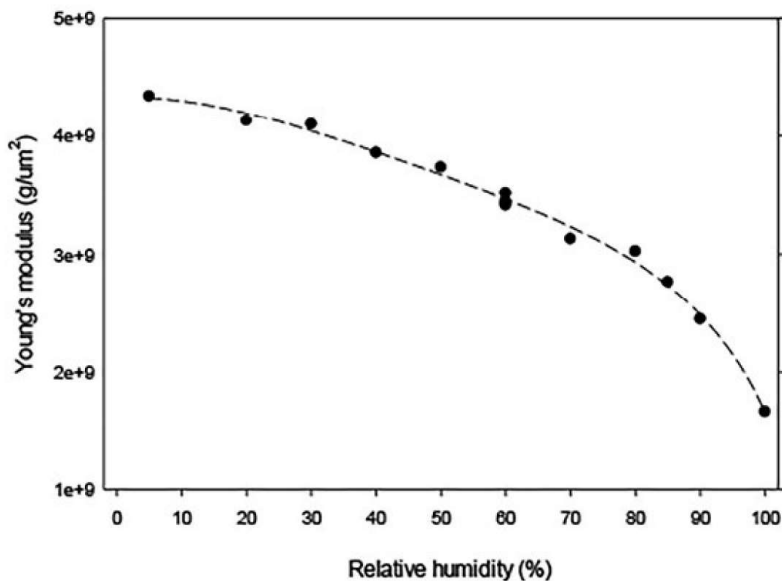


Type 1 Detailed Insert



Too Much Moisture Could be Detrimental

Young's modulus as a function of RH



Deforms
More
Readily



Evans, T (2016) Nonreactive Paths to Internal Changes: Modifying Hair's Structure from the Inside, Part 2 *Cosm Toil*

Table II

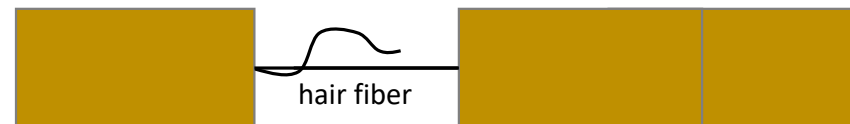
Break Stress (MPa) Data for African and Caucasian Hair From This and Other Studies at Two Different Climate Conditions

Study ^a	65% RH		100% RH	
	African	Caucasian	African	Caucasian
A	191	188	156	165
B	180	178	160	155
C	148	184	94	162
D	112	180	—	—
This study	155 ± 28	194 ± 13	122 ± 23	180 ± 16

^aThe African hair reported is tightly curled African hair.

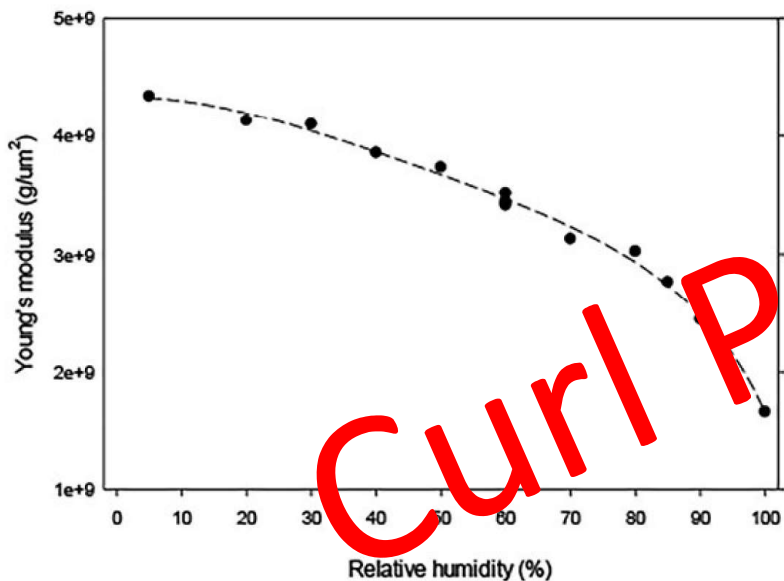
Source: Data from Studies A, B, C, and D, reported for four different locations, were published in a review article by Wolfram (6).

McMullen RL, Gillece, T, Schiess, T (2021) Physicochemical Properties of Textured Hair *J. Cosmet. Sci.*, **72**, 711–731



Too Much Moisture Could be Detrimental

Young's modulus as a function of RH



Deforms
More
Readily



Table II
Break Stress (MPa) Data for African and Caucasian Hair From This and Other Studies at Two Different Climate Conditions

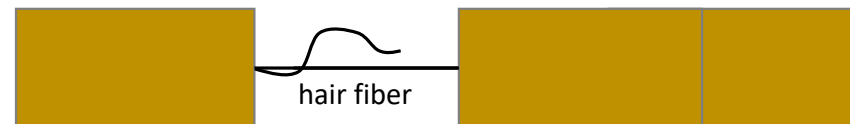
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McMullen RL, Gillice, T, Schiess, T (2021) Physicochemical Properties of Textured Hair *J. Cosmet. Sci.*, **72**, 711–731



Too Much Moisture Could be Detrimental When Using Heat



Average thermal appliances: 150 – 232 °C (302 – 450+ °F)

Denaturation Temperature of Hair: DRY = 235 – 250 °C (455 – 482 °F)

WET = 155 – 160 °C (311 – 320 °F)

Wortmann FJ, Sendelbach G, Popescu C. (2007) Fundamental DSC investigations of alpha-keratinous materials as basis for the interpretation of specific effects of chemical, cosmetic treatments on human hair. *J Cosmet Sci* **58**, 311–7

Marsh JM, Clarke CJ, Meinert K, Dahlgren RM. (2007) High pressure differential scanning calorimetry of colorant products. *J Cosmet Sci* **58**, 621–7

Wortmann FJ, Deutz H. (1993) Characterizing keratins using high-pressure differential scanning calorimetry. *J Appl Polym Sci* **48**, 137

Christian, P, Winsey, N, Whatmough, M, Cornwell, PA. (2011) The effects of water on heat-styling damage *J. Cosmet. Sci.*, **62**, 15–27

Takeaways

You're Not Crazy! Textured Hair Has Unique Needs

The Curlier/Coilier, The More TLC Needed

Elongated Hair ► Less Tangles ► Less Breakage

Wet Hair Combing: Handle With Care

Use Lubricating Products before Elongating

Drying & Styling Hair: Low Temperature Appliances

What You Can Do

Use a Good Rinse-Out & Leave-In Conditioner/Styler

Buy Products That Showcase Results on Your Hair Type

Demand MORE: Support Brands that Support YOU!

Find a Trusted Professional for Styling and/or Advise

Find a Trusted Researcher & Participate in Studies

Follow Jen on The Eco Well (and others like her)



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Sept 24th, 2023

Thank You!

Crystal Porter, Ph.D.

Mane Insights, Inc., President

Association of Professional Trichologists,
Executive Director

hairdoc@maneinsights.com