



Analysis of Visual Sensibility Evaluation of Naturally Colored Organic Cotton (NaCOC)

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Agenda

- Introduction
 - Background
 - Objectives
- Visual Sensibility Evaluation
- Results
- Conclusion

Naturally Colored Organic Cotton?

- ❑ A naturally pigmented fiber that grows in shades of ivory, green, or brown without artificial dyes
- ❑ Interests in NaCOC have increased rapidly with the social trend of wellbeing and eco-friendly living



Scouring Treatment Process

- The purposes of the scouring treatment (Tzanko et al., 2001)
 - Remove contaminants in the cotton
 - Improve fabric absorbency
- ⇒ Changes in the physico-mechanical properties (e.g., tensile strength & thickness) of fabrics including **color**



(1) untreated fibers



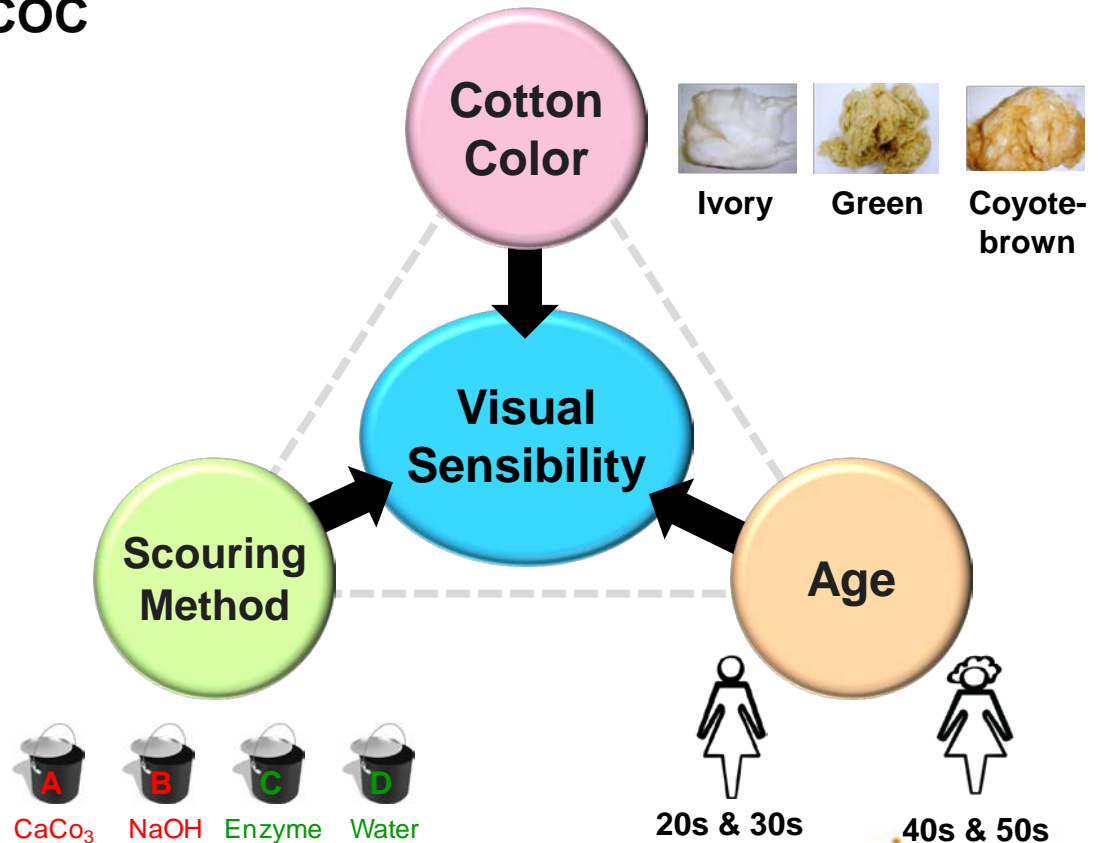
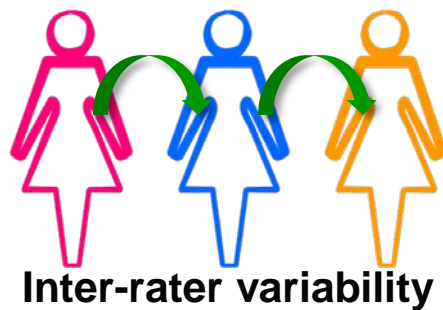
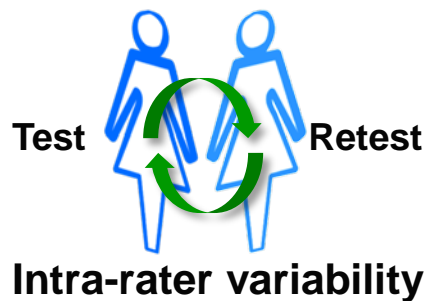
(2) scouring treatment



(3) treated fibers

Objectives of the Study

1. Identify **the intra- and inter-rater reliabilities** of a visual sensibility evaluation method
2. Identify the effects of age, NaCOC color, and scouring method on the **visual sensibility of NaCOC**



Participants

- Health condition: No color blindness

Attributes		Age Groups	
		20s & 30s	40s & 50s
# of participants		30	30
Age	Mean	25.8	49.3
	S.D.	3.3	5.7
	Range	21 ~ 34	41 ~ 58

Apparatus

- 9 pairs of bipolar visual sensibility adjectives (Lee & Nam, 2003; Woo & Cho, 2003)
















No	-	Very	Moderately	Slightly	Neutral	Slightly	Moderately	Very	+
1	Dark	-3	-2	-1	0	1	2	3	Bright
2	Murky	-3	-2	-1	0	1	2	3	Clear
3	Light	-3	-2	-1	0	1	2	3	Heavy
4	Subdued	-3	-2	-1	0	1	2	3	Vivid
5	Cool	-3	-2	-1	0	1	2	3	Warm
6	Stale	-3	-2	-1	0	1	2	3	Fresh
7	Weak	-3	-2	-1	0	1	2	3	Strong
8	Plain	-3	-2	-1	0	1	2	3	Showy
9	Cheap	-3	-2	-1	0	1	2	3	Luxurious

Cotton Specimens

- 3 color sets of NaCOC specimens including 1 untreated and 4 treated specimens

Chemical process

Natural process

Scouring method	N	Chemical process		Natural process	
	Untreated	A: CaCO_3	B: NaOH	C: Enzyme	D: Water
Color	Untreated	0.5g/L sodium carbonate & 1 g/L Tween 80	0.5g/L sodium hydroxide & 1 g/L Tween 80	100 g/L Pectinase , 50 g/L Cellulase, & 0.05M acetate buffer solution of PH 5.0	Boiling water
Ivory					
Green					
Coyote-brown					

Experimental Procedure

- ❑ Conducted the visual sensibility evaluation by the test-retest method
- ❑ Counterbalanced the evaluation order of color sets
- ❑ Presented the untreated specimen first followed by the treated ones in random order

1. Orientation of the experiment (5 min)



2. Test visual sensibility (30 min)

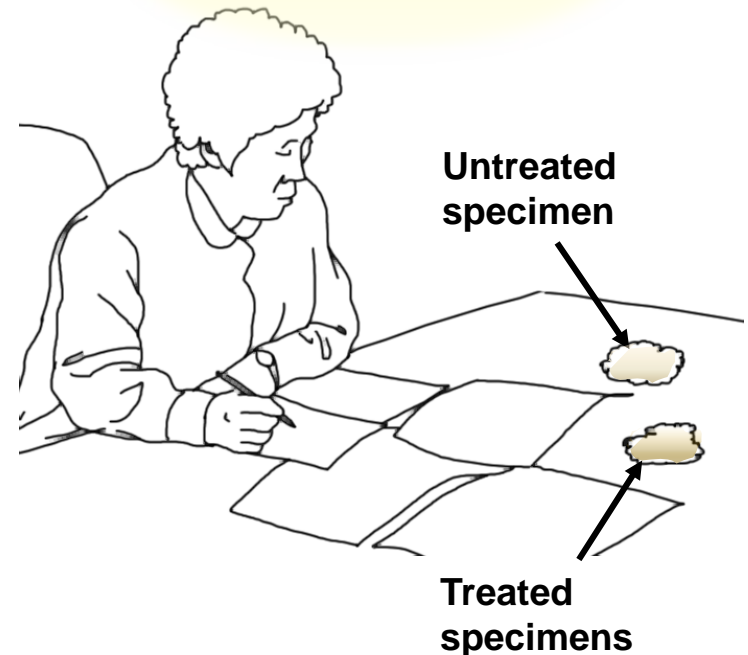


3. Break (5 min)



4. Retest visual sensibility (30 min)

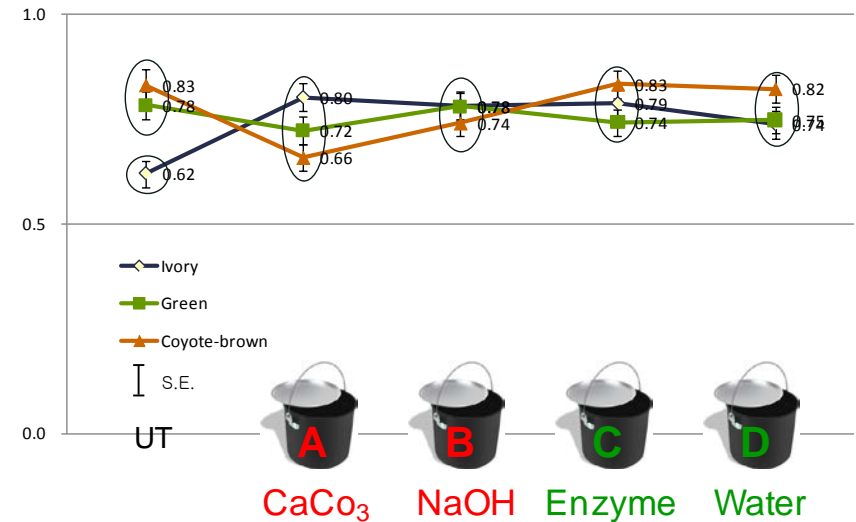
Lighting condition: 400 lux



Intra-Rater Reliability

- ❑ Four-factor mixed ANOVA (age, color, scouring method, and sensibility adjective)
- ❑ Only “color × scouring method” significant
- ❑ Average intra-rater SD: 0.62 ~ 0.83, showing no systematic pattern

Source	df	SS	MS	F
Age (A)	1	5.55	5.55	1.01
Subject (S) [A]	58	318.41	5.49	
Color (C)	2	1.41	0.71	0.31
A × C	2	3.33	1.66	0.73
S [A] × C	116	264.91	2.28	
Scouring method (M)	4	3.54	0.89	1.07
A × M	4	3.12	0.78	0.94
S [A] × M	232	192.41	0.83	
Sensibility adjective (SA)	8	5.83	0.73	1.19
A × SA	8	10.96	1.37	2.24
S [A] × SA	464	284.18	0.61	
C × M	8	22.58	2.82	2.57
S [A] × C × M	472	518.38	1.10	
C × SA	16	9.17	0.57	1.07
S [A] × C × SA	944	505.26	0.54	
M × SA	32	20.93	0.65	1.50
S [A] × M × SA	1888	825.19	0.44	
Error	3840	1692.33	0.44	
Total	8099	4687.49		



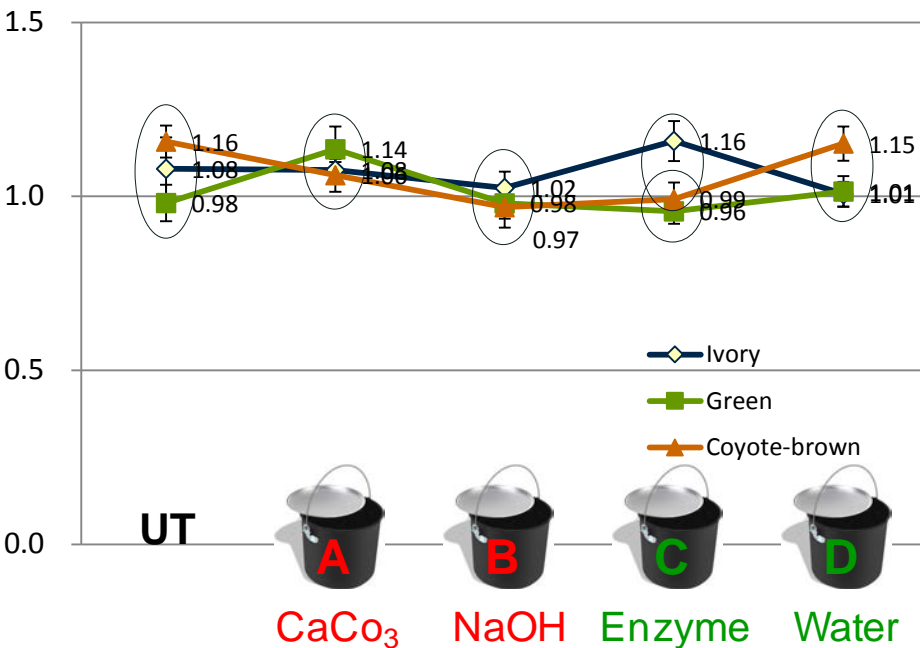
○ : grouped by SNK test at $\alpha = 0.05$

Significant results at $\alpha = 0.05$

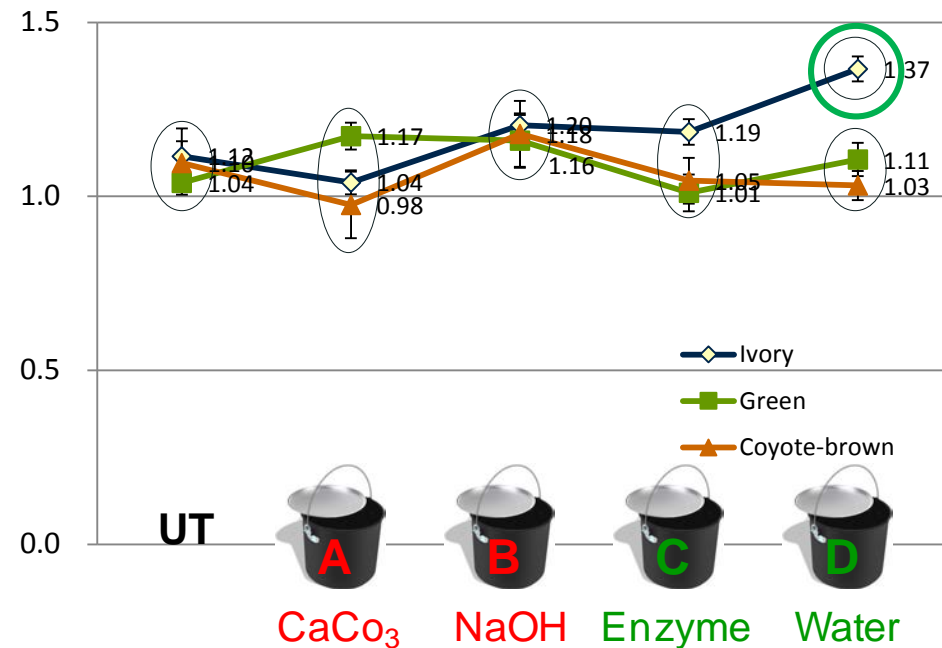
Inter-Rater Reliability

- Four-factor mixed ANOVA (age, color, scouring method, and sensibility adjective)
- Age × color × scouring method ($F(8, 64) = 3.41, p = 0.003$)
- Average inter-rater SD: 0.97 ~ 1.37, showing no systematic pattern
- Average intra-rater SD: 0.62 ~ 0.83

20s & 30s



40s & 50s



SNK test ($\alpha = 0.05$) ○

ANOVA for Sensibility Evaluation Data (p values)

- Three-factor mixed ANOVA (age, color, and scouring method)

Significant results at $\alpha = 0.05$

2-way interaction

3-way interaction

Sensibility adjective		Age (A)	Color (C)	Scouring method (M)	A × C	A × M	C × M	A × C × M
Bright	Dark	0.0029	<0.0001	<0.0001	0.0052	0.0028	<0.0001	0.0003
Clear	Murky	0.2067	<0.0001	<0.0001	0.0003	0.1111	<0.0001	0.0214
Heavy	Light	0.0017	<0.0001	<0.0001	0.1197	0.0398	<0.0001	0.0166
Vivid	Subdued	0.0079	<0.0001	<0.0001	0.4629	0.5204	0.0150	0.2871
Warm	Cool	0.0006	<0.0001	<0.0001	0.5208	0.0587	0.0001	0.0052
Fresh	Stale	0.4315	<0.0001	<0.0001	0.4943	0.1558	0.0004	0.2788
Strong	Weak	0.0005	<0.0001	<0.0001	0.0796	0.2005	0.0309	0.0024
Showy	Plain	0.1084	0.0006	0.0267	0.0535	0.2549	<0.0001	<0.0001
Luxurious	Cheap	0.0029	<0.0001	<0.0001	0.0052	0.0028	<0.0001	0.0003

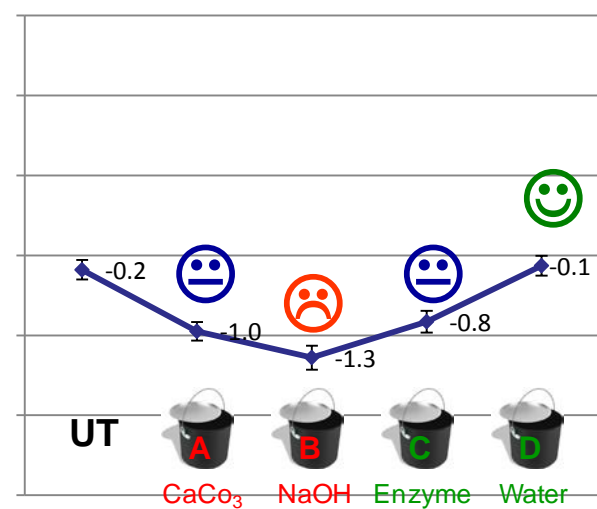
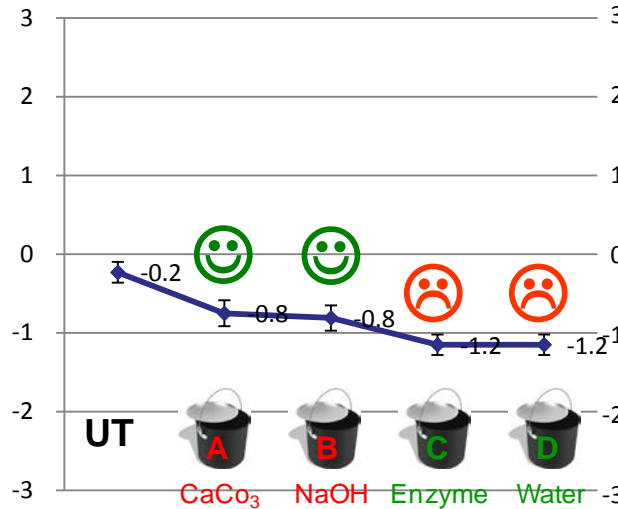
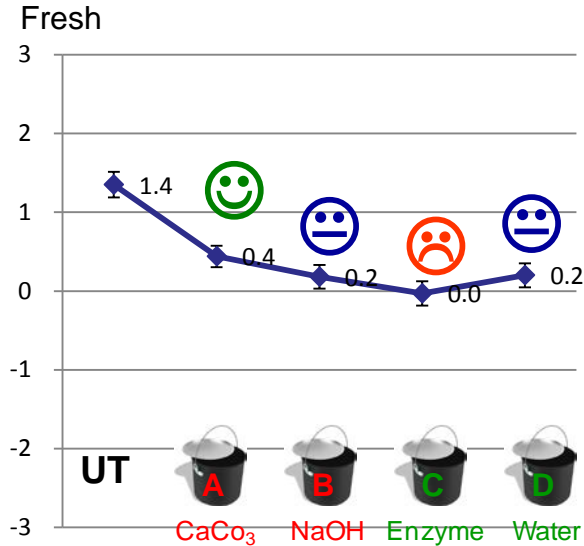
NaCOC Color & Age

NaCOC Color

Multiple Comparison for C × M: Fresh-Stale

Color	Age
	Pooled
Ivory	<u>C (0.0), B (0.2), D (0.2), A (0.4)</u>
Green	<u>C (-1.2), D (-1.2), B (-0.8), A (-0.8)</u>
Coyote-brown	<u>B (-1.3), A (-1.0), C (-0.8), D (-0.1)</u>

— No significant difference at $\alpha = 0.05$



Stale

Ivory

Green

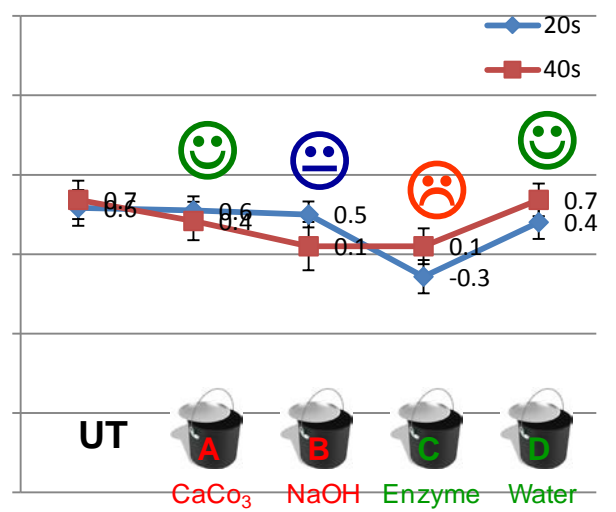
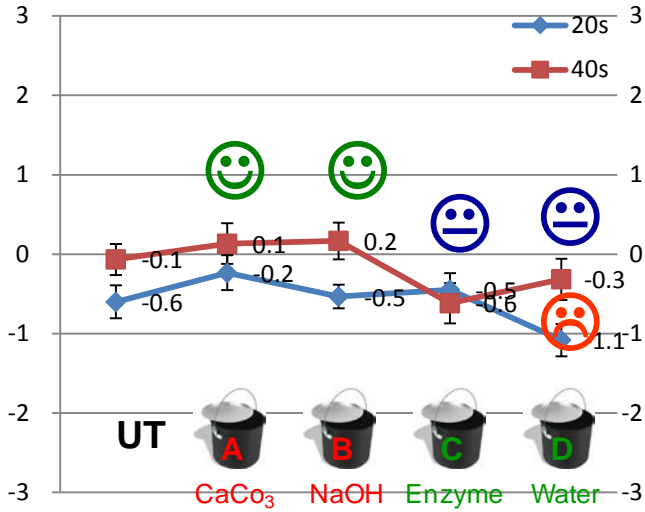
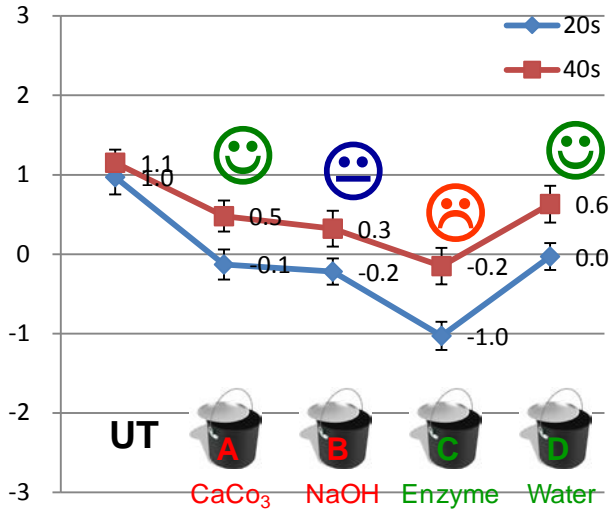
Coyote-brown

Multiple Comparison for A × C × M: Luxurious-Cheap

Color	Age		
	20s & 30s	40s & 50s	Pooled
Ivory	<u>C (-1.0), B (-0.2), A (-0.1), D (0.0)</u>	<u>C (-0.2), B (0.3), A (0.5), D (0.7)</u>	<u>C (-0.6), B (0.1), A (0.2), D (0.4)</u> 😊
Green	☹️ <u>D (-1.1), C (-0.5), B (-0.5), A (-0.2)</u>	<u>C (-0.6), D (-0.3), A (0.1), B (0.2)</u>	<u>D (-0.7), C (-0.6), B (-0.2), A (-0.1)</u> 😊
Coyote-brown	<u>C (-0.3), D (0.4), B (0.5), A (0.6)</u>	<u>C (0.1), B (0.1), A (0.4), D (0.6)</u>	<u>C (-0.1), B(0.3), A (0.5), D (0.5)</u>

— No significant difference at $\alpha = 0.05$

Luxurious



Cheap

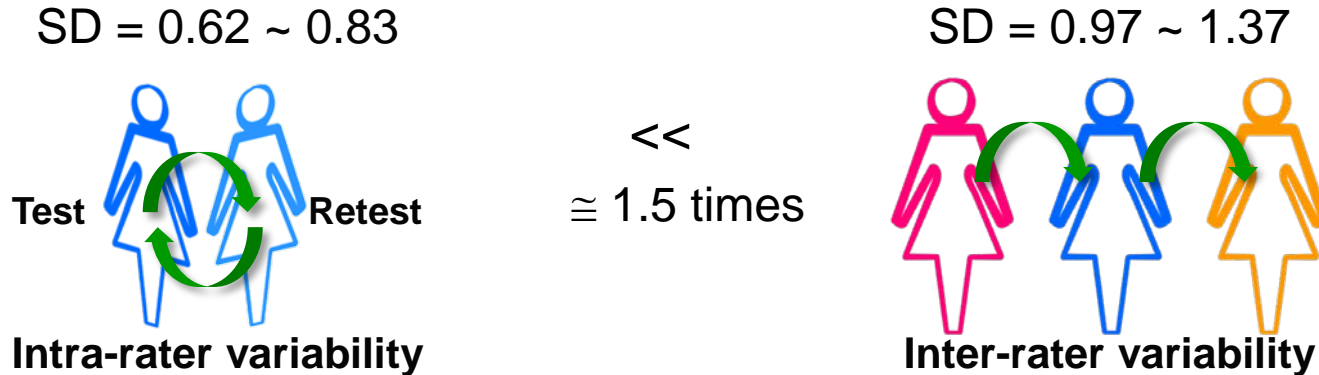
Ivory

Green

Coyote-brown

Conclusion: Reliability Evaluation

- Intra-rater vs. inter-rater reliabilities



- Both the intra-rater and inter-rater reliabilities of sensibility evaluation **did NOT show any systematic pattern** of changes (age, NaCOC color, scouring method, and sensibility adjective pair)

Conclusion: Visual Sensibility Evaluation

- **Preferred scouring methods** for the visual sensibility adjective pairs significantly vary depending on **NaCOC color** (major) and **age** (minor)

NaCOC Color	NaCOC Color & Age
Vivid – Subdued Fresh – Stale	Bright – Dark Clear – Murky Heavy – Light Warm – Cool Strong – Weak Showy – Plain Luxurious – Cheap

- An **environmentally friendly scouring method** such as **water** can be as effective as chemical methods such as CaCO_3 and NaOH

**Thank You
for Your Attention!**

