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

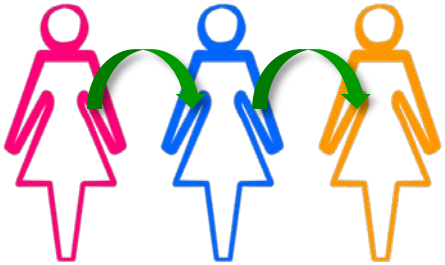
  ⇒ Changes in the physico-mechanical properties (e.g., tensile strength & thickness) of fabrics including **color**

(1) untreated fibers (2) scouring treatment (3) treated fibers

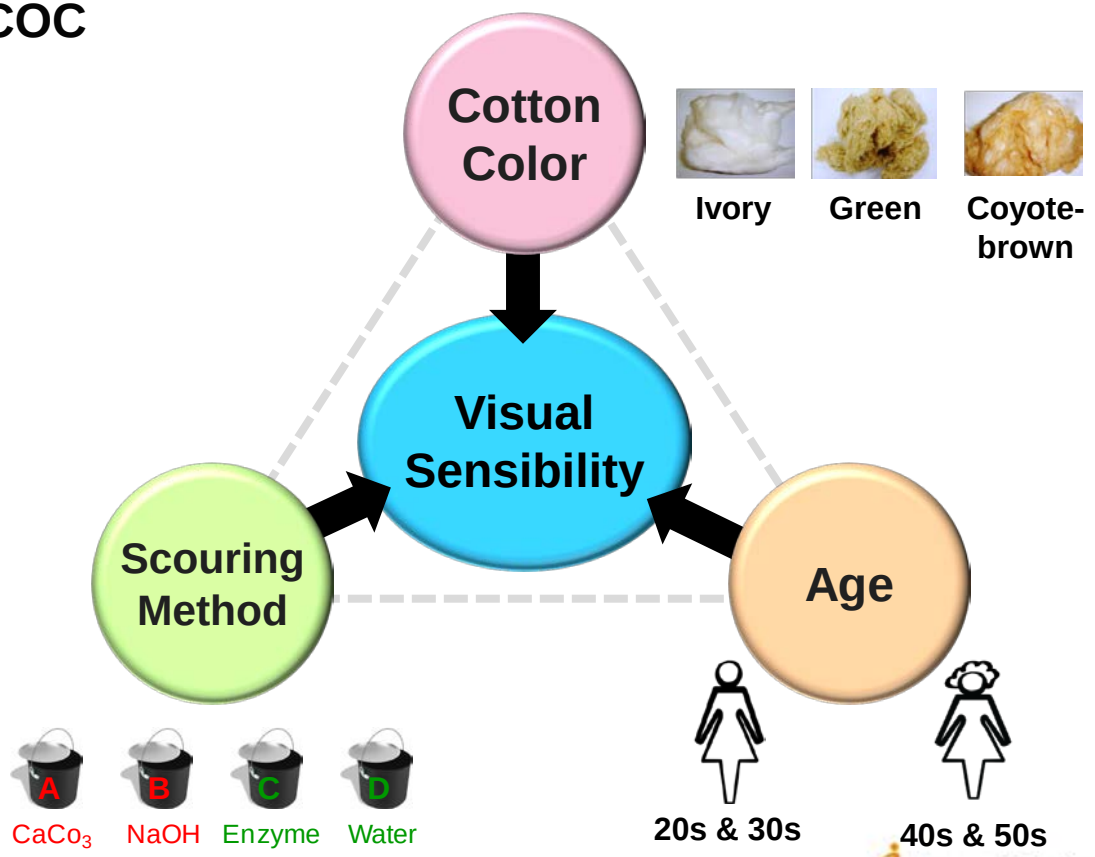
Objectives of the Study

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**

Intra-rater variability



Inter-rater variability



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

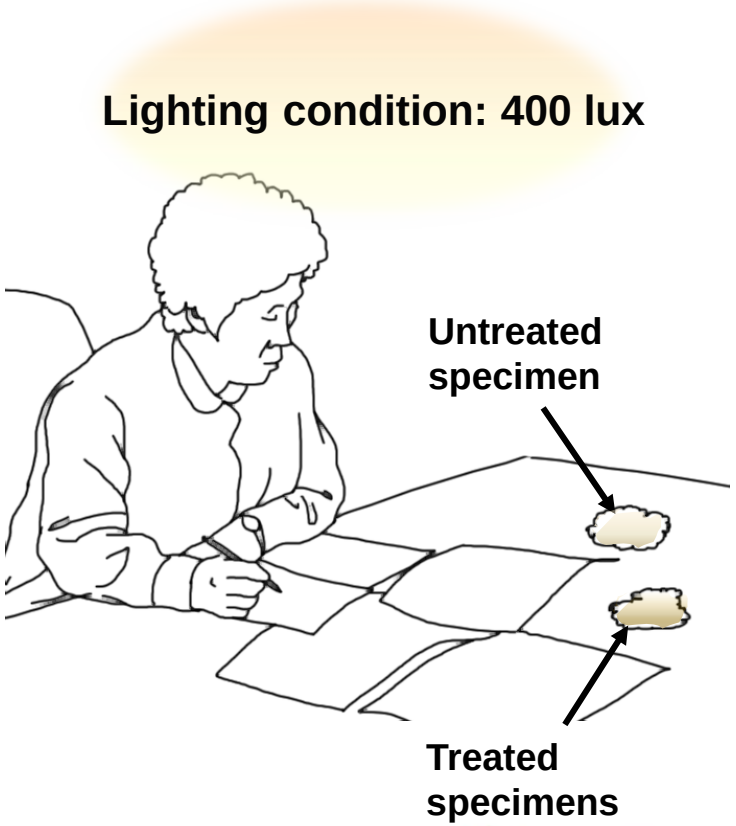
- 3 color sets of NaCOC specimens including 1 untreated and 4 treated specimens

		Chemical process		Natural process	
Scouring method / Color	N	A: $CaCO_3$	B: NaOH	C: Enzyme	D: Water
	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

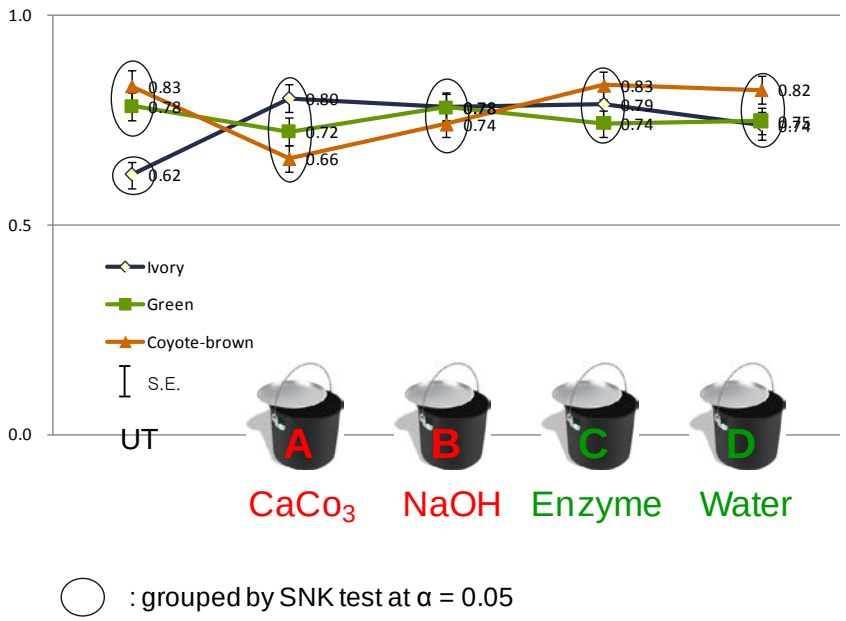
1. **Orientation of the experiment (5 min)**
2. **Test visual sensibility (30 min)**
3. **Break (5 min)**
4. **Retest visual sensibility (30 min)**



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		



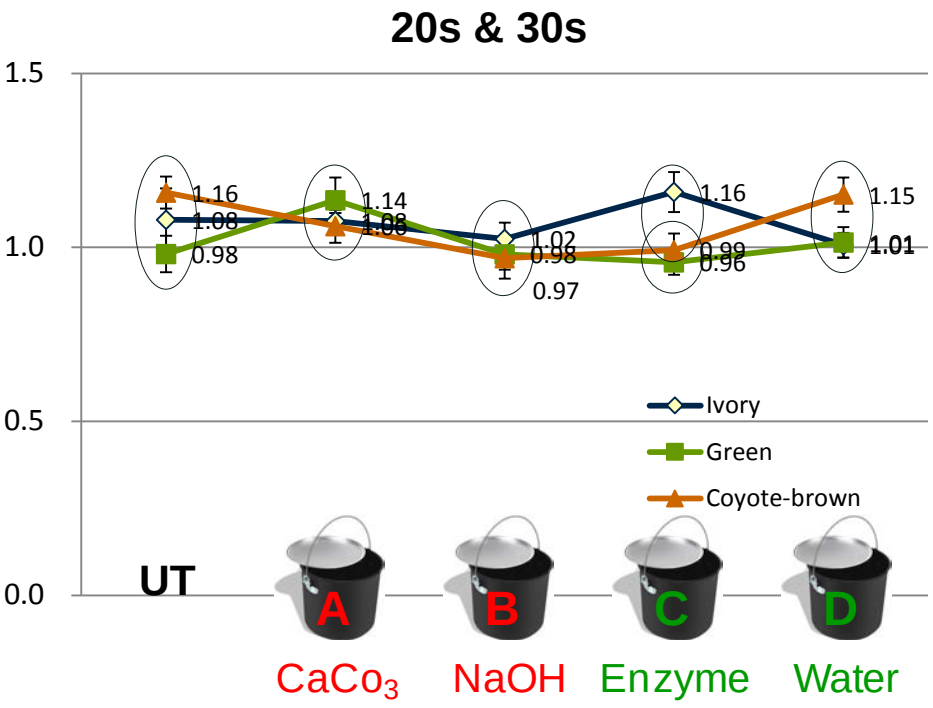
: grouped by SNK test at α = 0.05

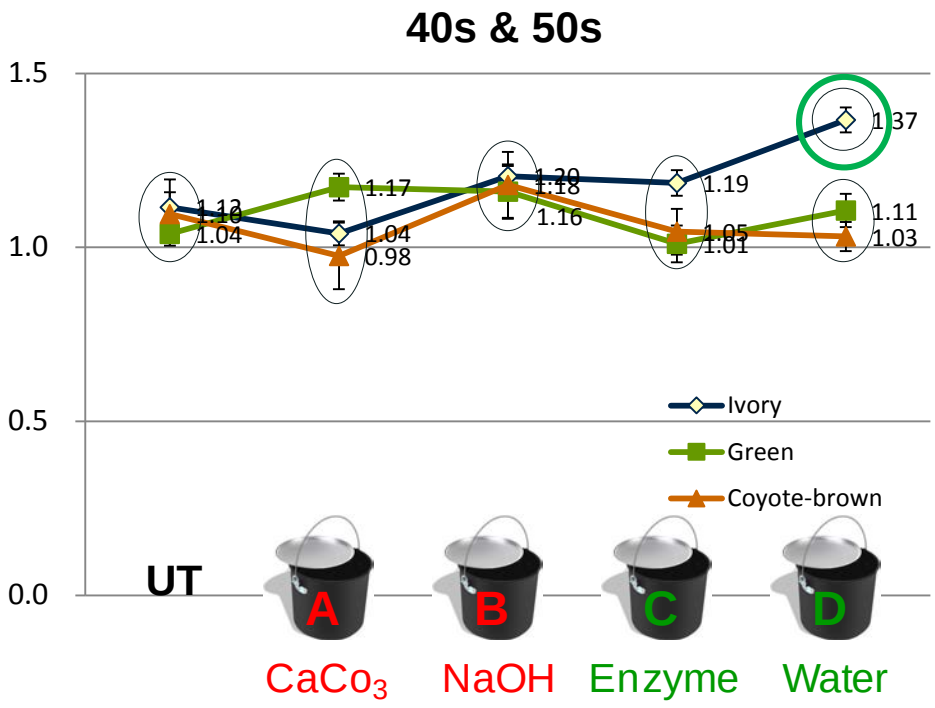
Significant results at α = 0.05

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





SNK test (α = 0.05)

ANOVA for Sensibility Evaluation Data (*p* values)

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

Significant results at α = 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	0.0070	<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

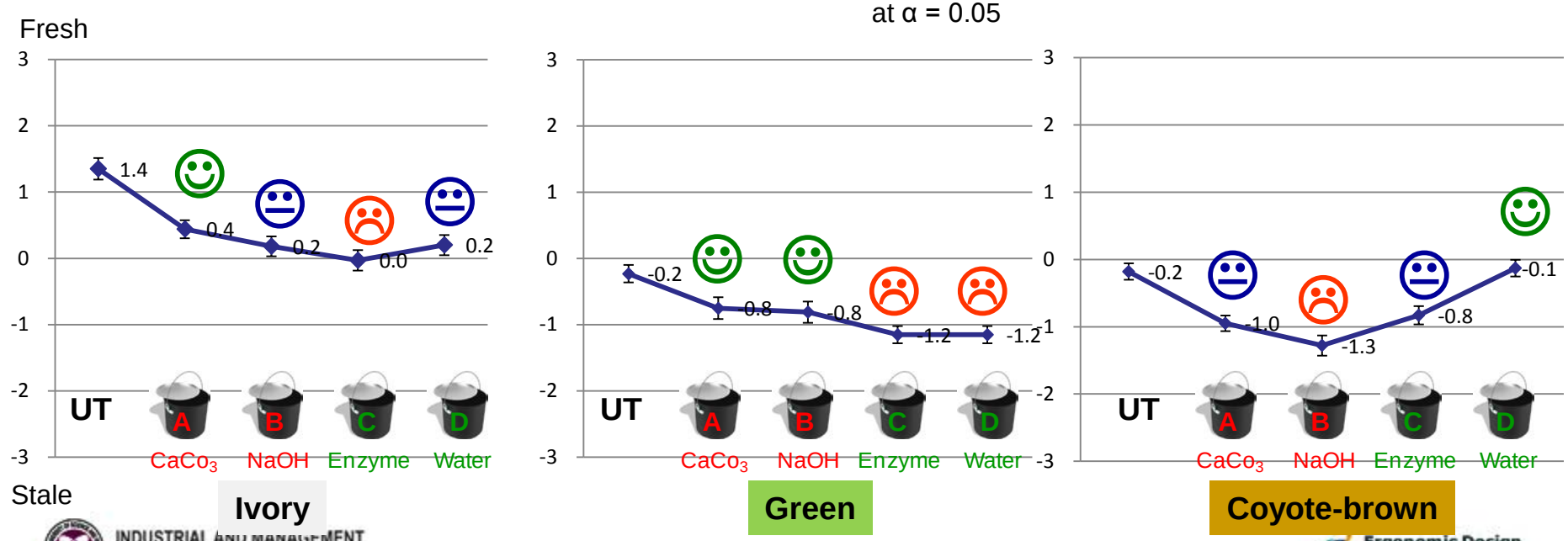
NaCOC Color & Age

NaCOC Color

Multiple Comparison for C × M: Fresh-Stale

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

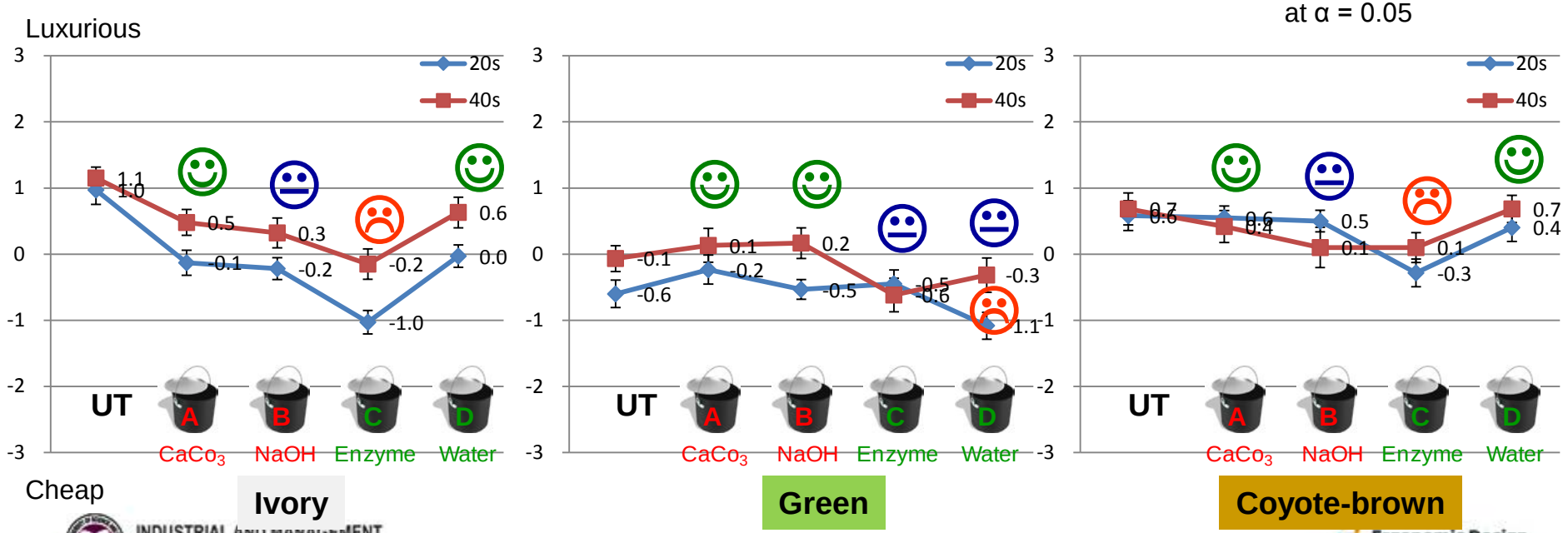
No significant difference at α = 0.05



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

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

No significant difference at α = 0.05



Conclusion: Reliability Evaluation

- **Intra-rater vs. inter-rater reliabilities**

SD = 0.62 ~ 0.83

Intra-rater variability

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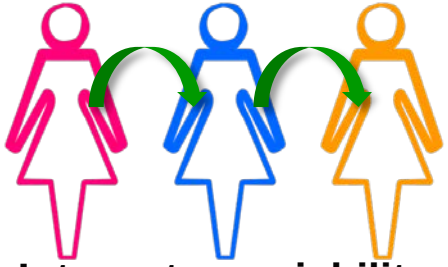
≅ 1.5 times

SD = 0.97 ~ 1.37



Inter-rater variability

- 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

Q & A

Thank You
for Your Attention!