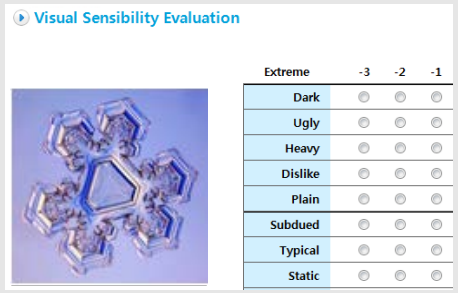
Development of a Textile Sensibility Evaluation System



W. Hong[1], J. Park[1], J. Jeong[1], M. Lee[2],
Y. Chae[2], M. Paik[2], Dr. G. Cho[2], and Dr. H. You[1]

[1] Dept. of Industrial & Management Eng., POSTECH, South Korea

[2] Dept. of Clothing & Textiles, Yonsei University, South Korea

AGENDA

- Background
- Objectives of the Study
- Textile Sensibility Evaluation System (TSES)
- Effectiveness Evaluation of TSES
- Discussion

Sensibility in Clothing & Textile Design

- Increased customer needs for sensible clothing and textiles.

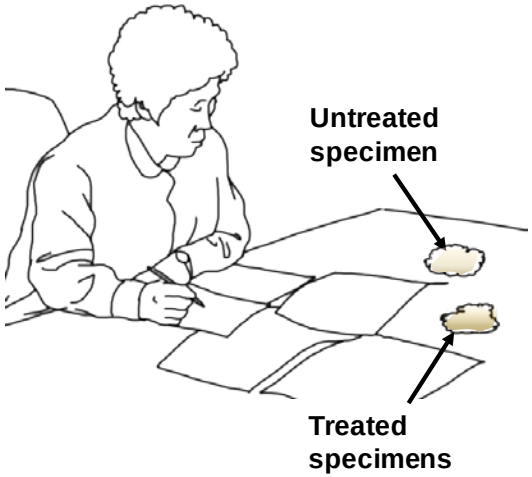
Touch sensibility

Visual sensibility

Auditory sensibility

Clothing & Textile Sensibility Research

- Chang et al. (2010) suggested preferred scouring methods (e.g. enzyme) for naturally colored organic cotton (NaCOC) fibers by conducting a visual sensibility evaluation



- Cho et al. (2001) developed a statistical model which predicts auditory sensibilities of a fabric by using its mechanical and acoustic property information

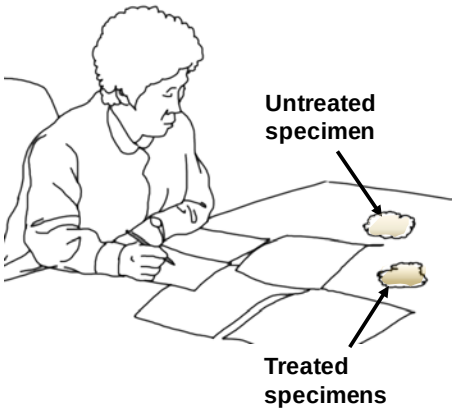
Sound Sensation	Regression Equation	R^2
Softness	Y =23.873-0.287**LPT** +0.032**EM**-0.168**2HG** +1.050**WC**-8.328**T**	0.999
Loudness	Y =-8.847-0.050**ΔL**+0.295**LPT** +5.109**T**	0.983
Pleasantness	Y =32.599-0.001**Δf**-1.343**WT**	0.780
Sharpness	Y =-4.181+0.00005**Δf** +0.128**LPT**-4.633**G** +12.782**T**	0.986
Clearness	Y = 4.566-0.0001**Δf** +0.8602**HG5**	0.709
Roughness	Y =-19.796+0.0001**Δf** +0.264**LPT**+0.163**RT** -4.904**G**+22.022**T**	1.000
Highness	Y =-2.335-0.138**ΔL**+0.249**LPT**	0.977
Satisfaction	Y =18.914 + 0.048 **ΔL** - 0.250 **LPT** - 4.366**T**	0.988

Paper & Pencil Questionnaire

- P&P questionnaire: Commonly employed in clothing & textile sensibility research for it is easy to administer and collect evaluation data

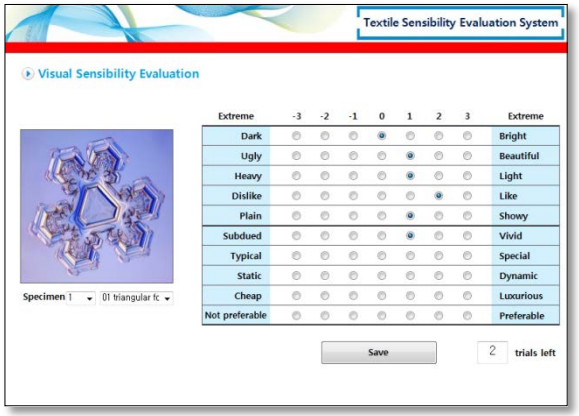
- Inefficiency in time and manning
  - The administrator presents specimens
  - Evaluation data are inputted to a computer
  - A significant time is needed to analyze the data

} Computerized system tailored to textile sensibility evaluation



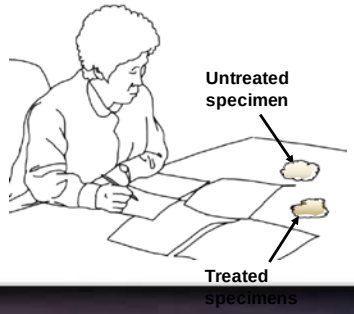
Objectives of the Study

1. Develop a textile sensibility evaluation system (TSES)

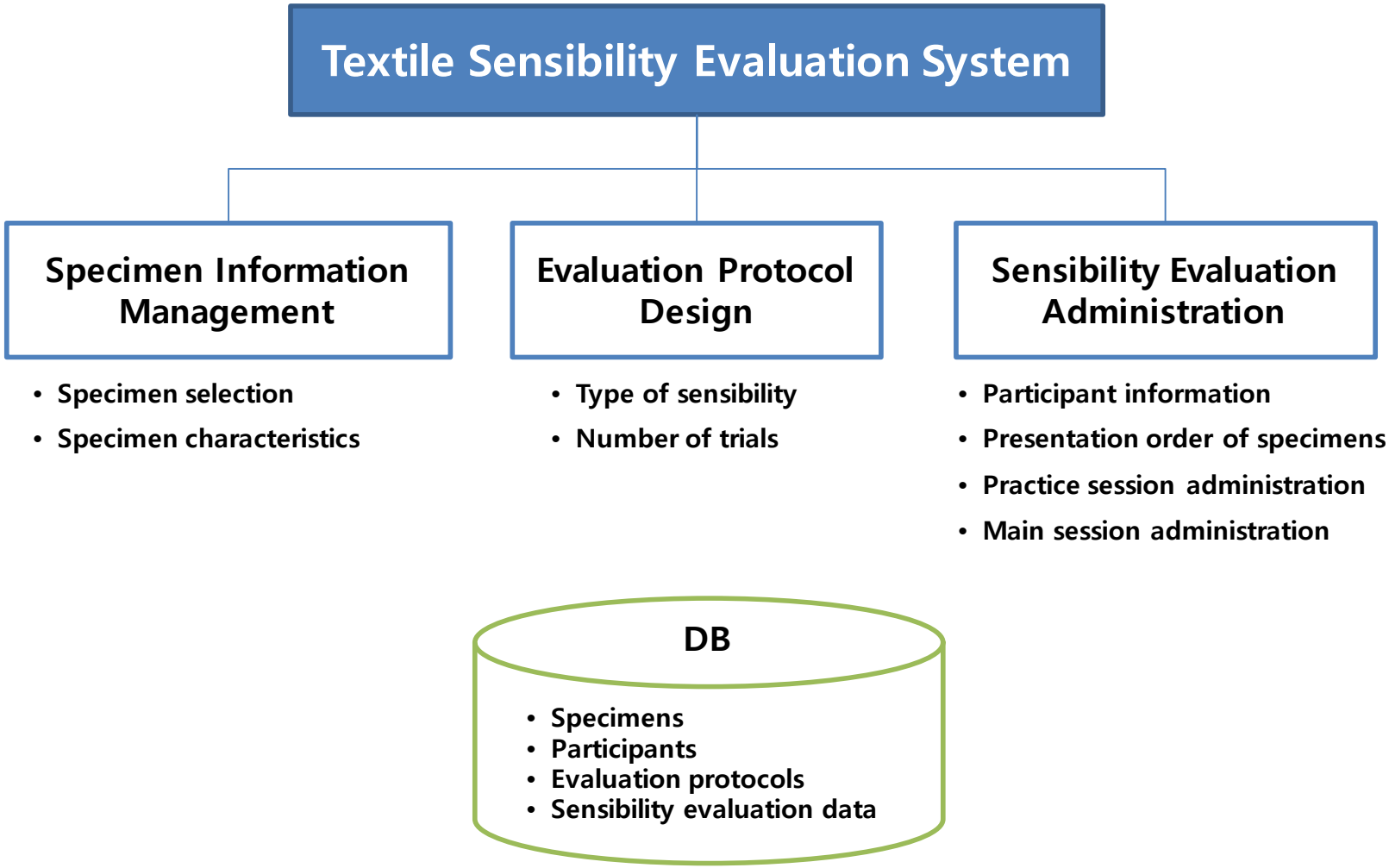


2. Examine the effectiveness of TSES
   - Statistical relationships in sensibility evaluation
   - Reliability in evaluation

P&P questionnaire vs. TSES



TSES Architecture

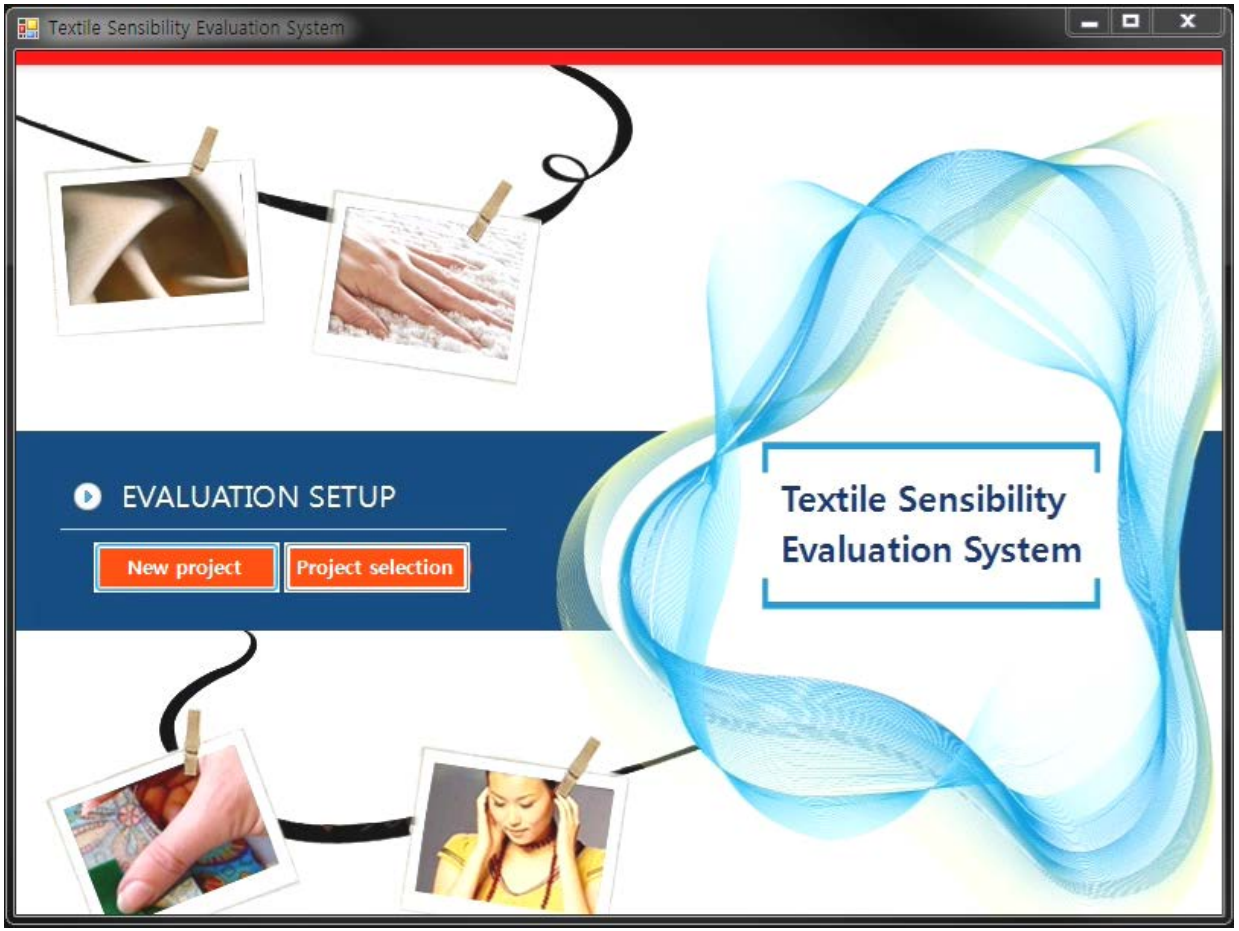


TSES Demo (1/3)

S1. **Specimen Information Management**

S2. Evaluation Protocol Design

S3. Sensibility Evaluation Administration

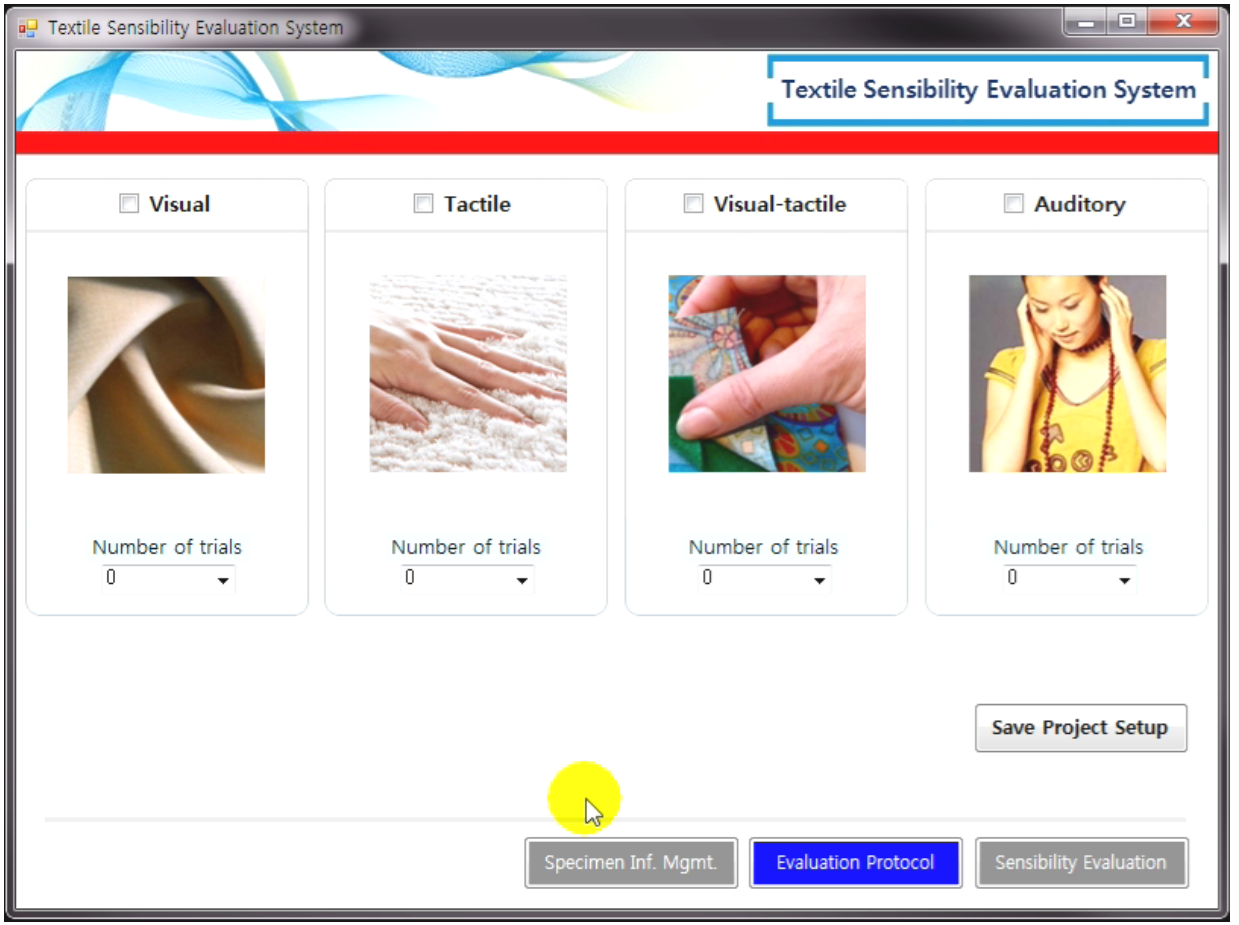


TSES Demo (2/3)

S1. Specimen Information Management

S2. **Evaluation Protocol Design**

S3. Sensibility Evaluation Administration

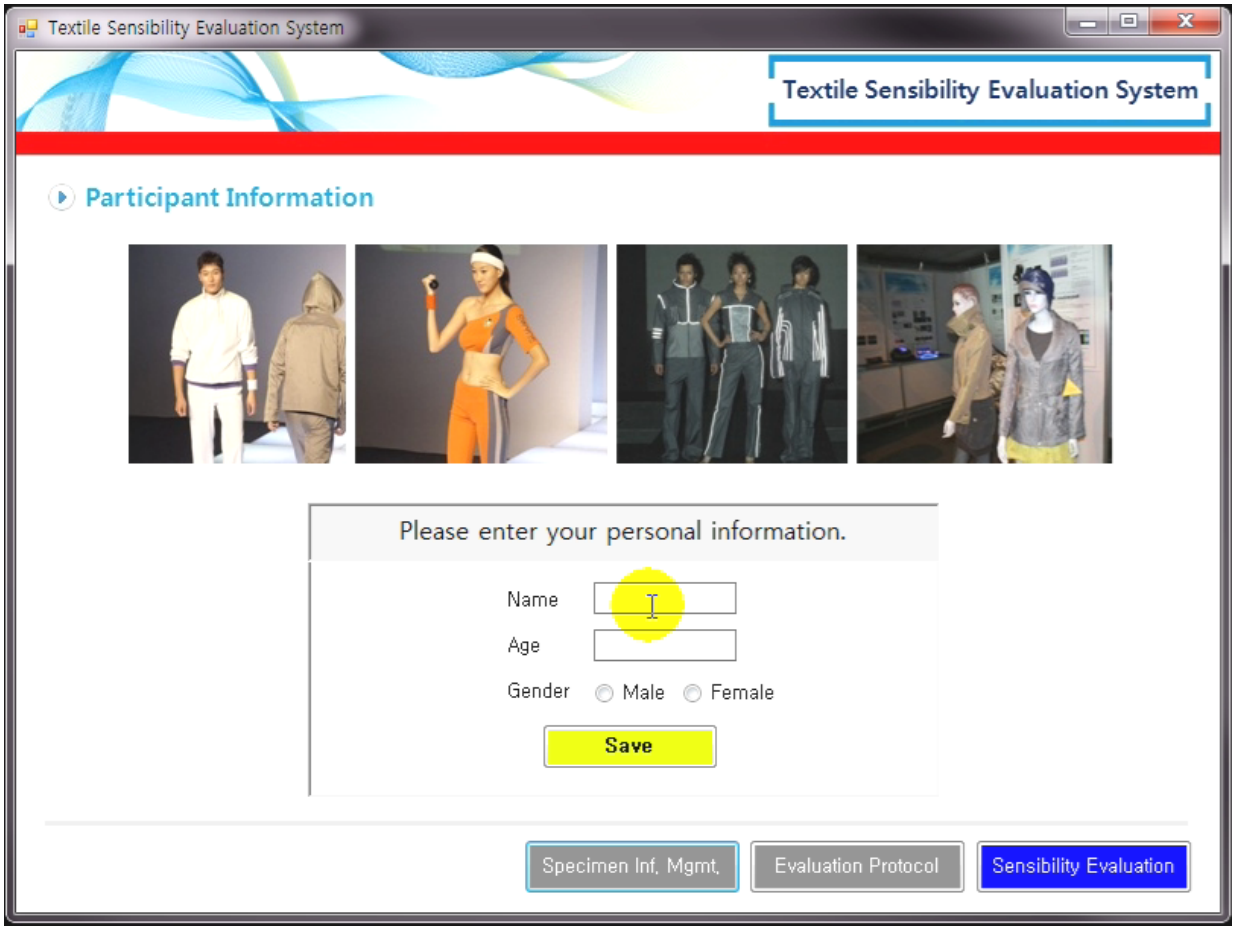


TSES Demo (3/3)

S1. Specimen Information Management

S2. Evaluation Protocol Design

S3. Sensibility Evaluation Administration

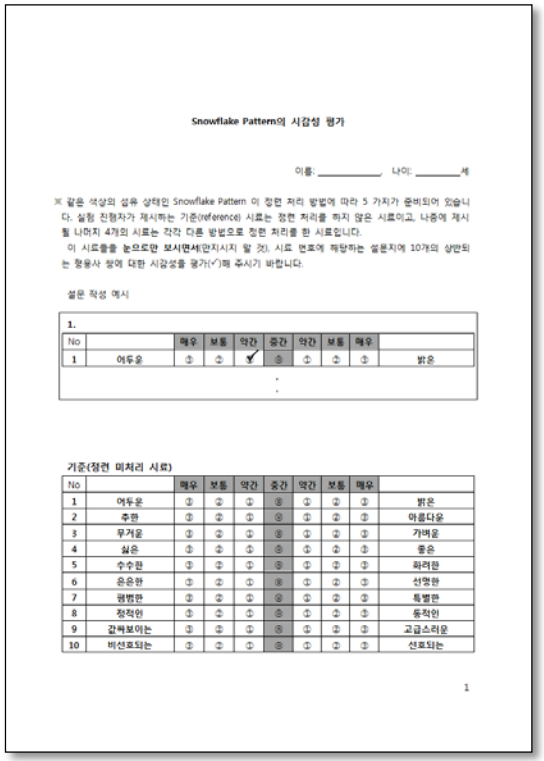


Effectiveness Evaluation Experiment: Participants

No. of Participants	**15**
Gender	**Female**
Age	**20s & 30s**
Health Condition	**Normal vision &** **No color blindness**

Experiment: Evaluation Methods

P&P Questionnaire



Snowflake Pattern의 시감성 평가

이름: _____ 나이: _____세

※ 같은 색상의 섬유 상태인 Snowflake Pattern 이 정련 처리 방법에 따라 5 가지가 준비되어 있습니다. 실험 진행자가 제시하는 기준(reference) 시료는 정련 처리를 하지 않은 시료이고, 나중에 제시될 나머지 4개의 시료는 각각 다른 방법으로 정련 처리를 한 시료입니다.
이 시료들을 눈으로만 보시면서(만지시지 말 것), 시료 번호에 해당하는 설문지에 10개의 상반되는 형용사 쌍에 대한 시감성을 평가(✓)해 주시기 바랍니다.

설문 작성 예시

1.

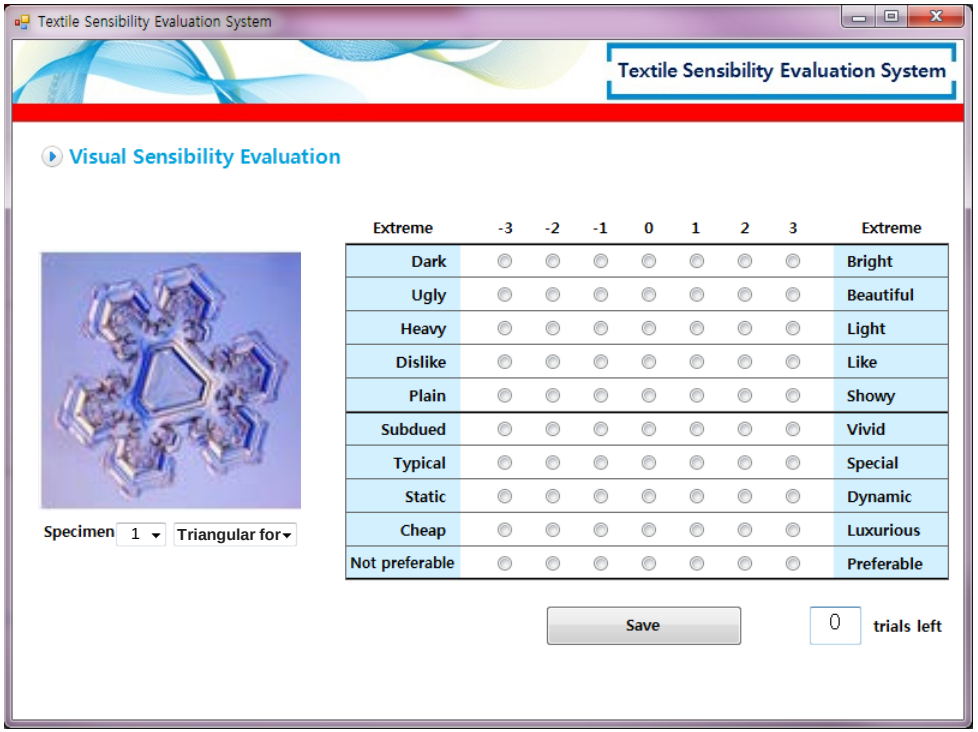
No		매우	보통	약간	중간	약간	보통	매우	
1	어두운	①	②	✓	③	①	②	③	밝은

기준(정련 미처리 시료)

No		매우	보통	약간	중간	약간	보통	매우	
1	어두운	①	②	①	③	①	②	③	밝은
2	추한	①	②	①	③	①	②	③	아름다운
3	무거운	①	②	①	③	①	②	③	가벼운
4	싫은	①	②	①	③	①	②	③	좋은
5	수수한	①	②	①	③	①	②	③	화려한
6	은은한	①	②	①	③	①	②	③	선명한
7	평범한	①	②	①	③	①	②	③	특별한
8	정적인	①	②	①	③	①	②	③	동적인
9	갈색보이는	①	②	①	③	①	②	③	고급스러운
10	비선호되는	①	②	①	③	①	②	③	선호되는

1

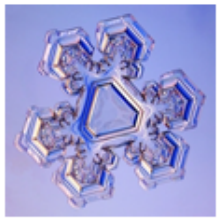
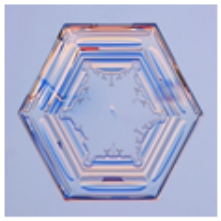
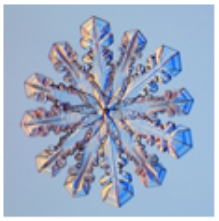
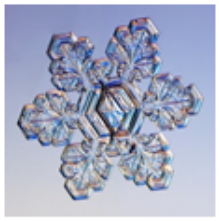
TSES

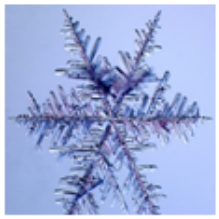
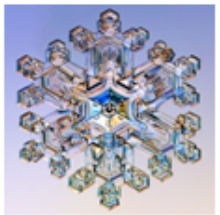
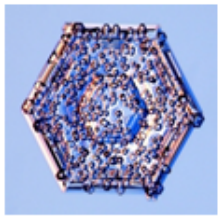


Experiment: Snowflake Patterns

- 11 snowflake patterns were selected by a group of experts in clothing and textiles for visual sensibility evaluation

Selected snowflake patterns

Triangular forms	Hexagonal plates	Branched stars	Stellar plates	Split plates and stars	Sectored plates
					

Radiating dendrites	Simple stars	Stellar dendrites	Rimed	Fernlike stellar dendrites
				

Experiment: Visual Sensibility Adjectives & Scale

- 10 pairs of bipolar visual sensibility adjectives (Lee & Nam, 2003; Woo & Cho, 2003) with a 7-point scale

No	-	Very	Moderately	Slightly	Neutral	Slightly	Moderately	Very	+
1	Dark	-3	-2	-1	0	1	2	3	Bright
2	Ugly	-3	-2	-1	0	1	2	3	Beautiful
3	Heavy	-3	-2	-1	0	1	2	3	Light
4	Dislike	-3	-2	-1	0	1	2	3	Like
5	Plain	-3	-2	-1	0	1	2	3	Showy
6	Subdued	-3	-2	-1	0	1	2	3	Vivid
7	Typical	-3	-2	-1	0	1	2	3	Special
8	Static	-3	-2	-1	0	1	2	3	Dynamic
9	Cheap	-3	-2	-1	0	1	2	3	Luxurious
10	Unpreferred	-3	-2	-1	0	1	2	3	Preferred

Experiment: Procedure

- Conducted the visual sensibility evaluation by the test-retest method (at least one day apart)
- Evaluation order: Counterbalanced

1. Orientation of P&P experiment (3 min)
2. Evaluation of visual sensibility using P&P questionnaire (10 min)
3. Break (3 min)
4. Orientation of TSES experiment (3 min)
5. Evaluation of visual sensibility using TSES (10 min)

Lighting condition: 400 lux

Effectiveness Evaluation Results: ANOVA

- No significant difference in visual sensibility evaluation by evaluation method

Source	*df*	SS	MS	*F*	*p*
Subject (S)	14	711.6	50.9		
Snowflake pattern (P)*	10	2026.9	202.7	14.26	<.01*
P × S	140	1989.7	14.2		
Sensibility adjective (A)*	9	166.5	18.5	8.31	<.01*
A × S	126	280.4	2.2		
Evaluation method (M)	1	22.6	22.6	3.15	.10
M × S	14	100.5	7.2		
P × A*	90	1205.3	13.4	8.51	<.01*
P × A × S	1260	1983.4	1.6		
P × M	10	79.9	8.0	1.63	.10
P × M × S	140	684.6	4.9		
A × M	9	19.9	2.2	1.84	.07
A × M × S	126	151.0	1.2		
P × A × M	90	104.8	1.2	1.25	.06
Error	1260	1173.3	0.9		
Total	3299	10700.3			

Not significant at $\alpha = .05$

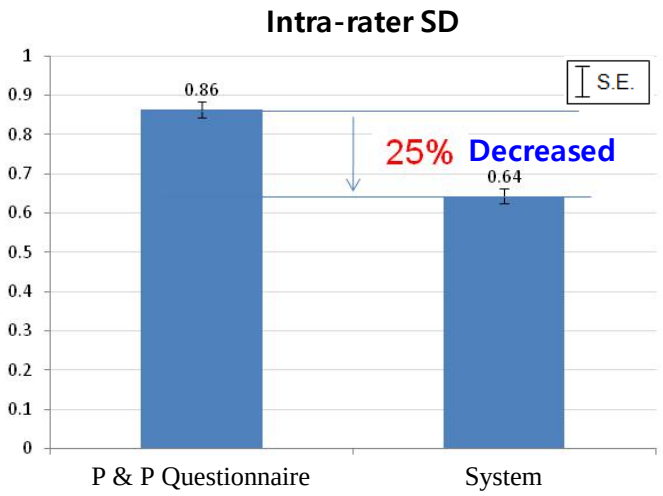
Results: Correlation Analysis

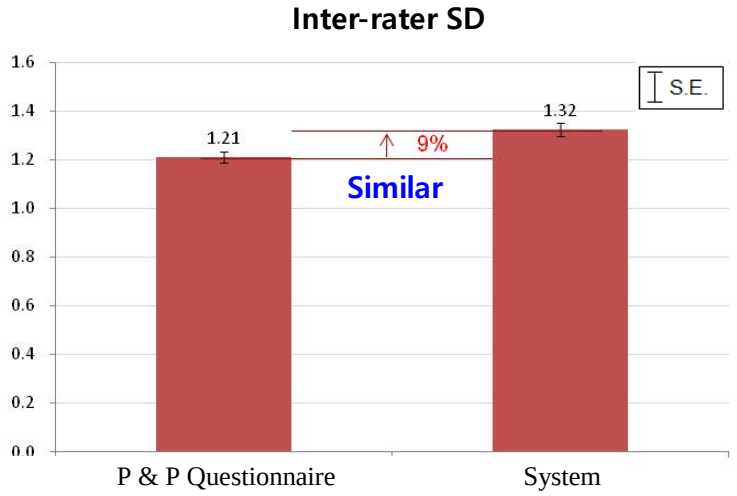
- Significantly high correlations (r = .88 ~ .97; ρ = .56 ~ .92) between P&P evaluation and TSES evaluation

Visual sensibility adjective pairs	Pearson's correlation		Spearman's rank correlation	
	r	*p-value*	*ρ*	*p-value*
Bright – Dark	.93	<.001	.56	.072
Beautiful – Ugly	.96	<.001	.88	<.001
Heavy – Light	.97	<.001	.72	.017
Like – Dislike	.93	<.001	.79	.004
Gorgeous – Plain	.95	<.001	.91	<.001
Vivid – subdued	.88	<.001	.71	.019
Special – Typical	.95	<.001	.89	<.001
Dynamic – Static	.96	<.001	.92	<.001
Luxurious – Cheap	.91	<.001	.76	.007
Preferred – Unpreferred	.93	<.001	.80	.005

Result: Reliability Analysis

- Intra-rater SD: P&P Questionnaire > TSES (25% ⇓, better reliability in repeated evaluation)
- Inter-rater SD: P&P Questionnaire ≅ TSES (9% ⇑, better discriminability between raters)





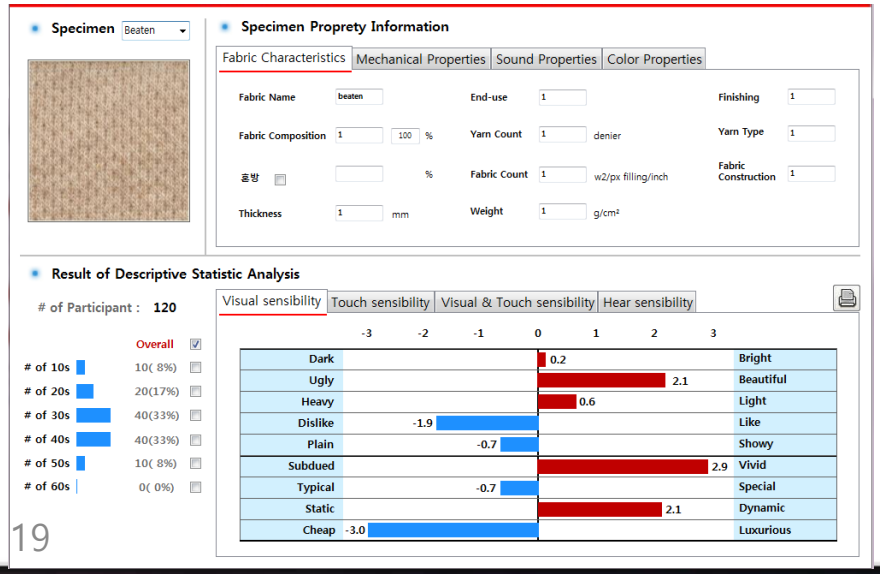
Method	Intra-rater SD				Inter-rater SD			
	Mean	SD	Min	Max	Mean	SD	Min	Max
P & P Questionnaire	0.86	0.14	0.62	1.07	1.21	0.14	1.04	1.50
System	0.64	0.15	0.33	0.78	1.32	0.10	1.14	1.45

Discussion

- Developed a textile sensibility evaluation system for efficient administration & data management in terms of time and manning
- Found TSES more effective than P&P questionnaire
  - Highly correlated
  - Better reliability in evaluation

  ⇒ Can replace P&P questionnaire

- Future work: Analysis modules



Q & A

Thank You for Your Attention!

Acknowledgement

This research was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science, and Technology (2010-0028229).