# The Emotional Expression for Eco-friendly Materials

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Abstract: In order to see the relationship between eco-friendly materials and emotional expression, current study carried out three experiments. The participants were ask to write down (1) the adjectives describing the concept of "eco-friendly" and (2) what object will be associated with the concept of "eco-friendly" in Experiment I. The data collected in Experiment I were used in Experiments II and III to see the inter-relationship between adjectives and explore the relationship between associations and adjectives. Additionally, the results were used compared with Eco-indicator 99 index. The results showed the adjective of "rough" and recycled paper were found to be the most frequently appearing feeling and association, respectively. According to inter-relationship between adjectives, one-dimensional emotional space for eco-friendly was developed. It can be defined as "natural" and "artificial." Eco-indicator 99 pointed out the PET is harmful to environment, but PET bottle was associated with eco-friendly. Additionally, carton was indicated as eco-friendly by Eco-indicator 99, but carton was not associated with eco-friendly.

Key words: Eco-friendly, material, emotion, Eco-Indicator 99

## **1. Introduction**

Nowadays, people realize how important the mother earth means to us. Perhaps the best way to protect earth is not to consume. However, take the living quality into account, this is out of consideration. How to keep a balance between living quality and eco-friendly is more likely to be the solution. To do this, manufactory, designer, and customer are needed to be involved. Normally, the eco-friendly products cost more than non-eco-friendly products, leading that manufactories are unwilling to take this risk. This also causes the designers not to use eco-friendly materials. In order to encourage manufactory to invest in producing eco-friendly products, the eco-friendly products are needed to be acknowledged by customers. The ideal purchasing situation is that the manufactories provide eco-friendly products and the customers purchase eco-friendly product. But in the current market, some products are eco-friendly, some aren't. The purchasing situation that customers faced can be concluded four types, as shown in Figure 1. Type 1 indicates that eco-friendly products are identified as eco-friendly by customers. Type 2 is that eco-friendly products are identified as non-eco-friendly. Type 3 is that eco-friendly products are recognized as non-eco-friendly. Type 4 shows non-eco-friendly products are acknowledged as non-eco-friendly. To achieve ecological purchasing, Type 1 is the ideal one, even Type 4 is acceptable. But Types 2 and 3 are unfavorable to ecological environment. To achieve Type 1 and avoid Types 2 and 3, the expression of product delivered to customers is needed to be consistent with how much the product go green.

	The product identified as eco-friendly		The product identified as non-eco-friendly	
eco-friendly products	1.		2.	
non-eco-friendly products	3.	😿 ⇒ 🙂	4.	

Figure 1: Four situations of purchasing product

## 2. Literature review

To understand eco-friendly design and the expression of product, this study reviewed the studies related to ecological design and emotional expression of materials.

Many studies<sup>1-4</sup> have been devoted to the study of ecological design. They suggested systematically evaluating how much each stage of design process influences the environment. These studies also indicated that the impact of life cycle of product is the most important criteria to judge how much this product go green. To minimize the environment impact, these studies emphasize on the material selection. For materials selection, ECMA 341 <sup>5</sup> provided information and communication technology and consumer electronic products a check list and compatibility of various thermoplastics to assist designers using the materials which has less impact on environment. Besides, Eco-Indicator 99 <sup>6</sup> provided a damage oriented method for life cycle impact assessment based on excavation of raw materials, manufacture, use and disuse. Eco-Indicator 99 also provided each material an index to indicate how much the material influence the environment, higher index means greater impact. From these studies one general point becomes very clear that material selection is the key to ecological design.

In terms of materials selection, Hollins *et al.*<sup>7,8</sup> investigated 17 materials to see how these materials influence people's feelings. The results showed that five pairs of emotion scales were significant for defining tactile materials, including "hard-soft", "cool-warm", "flat-bumpy", "smooth-rough", and "slippery-sticky" scales. It was also found that these five scales have significant inter-correlation. The scales of "smooth-rough" and "soft-hard" were found to be basic emotion for describing tactile materials. Additionally, Picard *et al.*<sup>9</sup> explored a little further into the relationship between occurrence frequencies of adjectives and emergence sequence toward materials. The results showed that the relationship is positive, i.e., the adjectives more frequently occurred, the earlier they emerged. The adjectives emerged with high frequency and early emerging order can be called "generic" feeling. By contrast, the adjectives with low frequency and later emerging order can be called "peripheral" feeling of materials. The generic feelings of materials included soft, warm, harsh, rough, silk, and pleasant.

In conclusion, the ecological design aims to minimize the environmental impact caused by product design. The most efficient way is to select the materials with less environmental impact. If the product made by eco-friendly materials can be acknowledged as eco-friendly, the ecological design can be seen as successful. This drives us to the question whether the customers can identify the eco-friendly materials or not. To understand this, this study planed three experiments to see the relationship between eco-friendly materials and emotional expression.

## 3. Experimental plan

To understand the emotional expression for eco-friendly materials, three experiments were carried out. Experiment I used open questionnaire to ask participants to write down (1) the adjectives describing the concept of "eco-friendly" and (2) what object will be associated with the concept of "eco-friendly". Thirty-two participants were invited in this experiment, including 17 males and 15 females, the age ranged between 22 and 28 years old. The adjectives collected in Experiment I were used in Experiment II to see the interrelationship between adjectives, aiming to develop the emotion space of materials. The associations collected from Experiment I were used to explore the relationship between adjectives and associations in Experiment III.

In Experiments II and III, the participants were asked to make judgment whether two items are correlated with each other. If two items are correlated with each other, the answer is given to 1; otherwise 0. Thirty-three and thirty-five participants took part in Experiments II and III, respectively. The participants in Experiment II included 17 males and 16 females, Experiment III 19 males and 16 females, the age ranged between 20 and 33 years old. Note that the panels of participant in three experiments were different, but they all are undergraduates and postgraduates in the Design College at Tatung University, Taiwan.

Additionally, in order to see how different between the materials identified as eco-friendly by participant and the materials indicated as eco-friendly by Eco-indicator 99 index, the data obtained from Experiment I were used to compare with Eco-indicator 99 index.

## 4. Result

In order to understand how people describe the concept of "eco-friendly", the data obtained from Experiment I were calculated. The frequency of each adjective and association was drawn in bar chart, as shown in Figure 2 and Figure 3. The adjective of "rough" was found to be the most frequently appearing feeling, followed by green, recyclable, decomposable, natural, and clean. It was also found that recycled paper has highest frequency, followed by lumber core board, Polylactide (PLA), green, PET bottle, tree, recyclables, and paper.



Figure 2: The emotions of eco-friendly materials



Figure 3: The association of eco-friendly materials



Figure 4: The emotion space of eco-friendly concept

To find out the inter-relationship between the adjectives collected, the data obtained from Experiment II were

analyzed by using Multidimensional Scaling analysis. Two dimensions was identified, however, the stress index for multidimensional scaling is 0.00506, indicating that one dimension is sufficient to explain the interrelationship between adjectives. The same method was applied again. One dimension space revealed the interrelationship between adjectives, named emotion space of eco-friendly, as given in Figure 4. It can seen that the "expensive", "clean", and "white" feelings are located at the one end, the "rough", "original", and "impure" feelings are located on the other end. The one end tended to "expensive" is named as "artificial"; another end tended to "rough" is named as "natural." This reflected that the emotion of "eco-friendly" can be defined by one dimensional space consisted of "artificial" and "natural."

Furthermore, to understand the relationship between association and emotions of eco-friendly, the data obtained from Experiment III were calculated. The mean results higher than 0.5 indicates a significant correlation between emotions and associations. The results are given in Figure 4. It can be seen that the silk, stone paper, bamboo, and lumber core board are associated with "expensive" emotion, indicating these associations are tended to be "artificial." By contrast, scouring pad, Eco-denim by recycled Polyethylene Terephthalate (PET), and denimwas were found to be associated with "rough" emotion, reflecting these associations are tended to be "natural."



Figure 5: The data obtained from Experiment I were plotted against the Eco-Indicator 99 index

Furthermore, in order to understand the difference between the eco-friendly materials identified by people and by Eco-indicator 99, the associations of eco-friendly collected from Experiment I were compared with Eco-Indicator 99 index. The frequency of associations and the Indicator 99 index were converted to standardized scores and plotted against each other, as shown in Figure 5. In Figure 5, the vertical axis means standardized score of Indicator 99 index; the horizontal axis means standardized score of frequency of associations. Additionally, a 45° line is given in the diagram to see how well the two data sets are correlated with each other. Data points fall on the second and fourth quadrants represent associations are consistent with Eco-indicator 99, the first and third quadrants conversely.

It can be seen that the data points are distributed close to 45° line; only three points are deviated from 45° line. This reflected that the objects associated with eco-friendly were consistent with those indicated by Eco-Indicator 99 index. The associations of PET, Aluminum, and Carton toward eco-friendly were found to be inconsistent with Eco-indicator 99 index. This revealed that Eco-indicator 99 pointed out the PET is harmful to environment, but PET bottle was associated with eco-friendly. Additionally, carton was indicated as eco-friendly by Eco-indicator 99, but carton was not associated with eco-friendly.

## 5. Conclusions

In order to understand the emotional expression for eco-friendly materials, three experiments were carried out. Current study explored what adjectives are used to describe eco-friendly and what objects are associated with eco-friendly. The results, furthermore, were used to compare with Eco-indicator 99 index. The findings are summarized below.

- 1. The adjective of "rough" was found to be the most frequently appearing feeling, followed by green, recyclable, decomposable, natural, and clean.
- 2. It was found that recycled paper has highest frequency, followed by lumber core board, Polylactide (PLA), green, PET bottle, tree, recyclables, and paper.
- 3. Emotional space of eco-friendly can be defined by a one-dimensional space. At the ends of this dimension are "natural" and "artificial."
- 4. Silk, stone paper, bamboo, and lumber core board were associated with artificial emotion. By contrast, scouring pad, "Eco-denim by recycled Polyethylene Terephthalate (PET)", and "denimwas" were found to be associated with "natural" emotion.
- 5. Eco-indicator 99 pointed out the PET is harmful to environment, but PET bottle was associated with ecofriendly. Additionally, carton was indicated as eco-friendly by Eco-indicator 99, but carton was not associated with eco-friendly.

Although many important findings were found in current study, there is a room for further improvement and development. For example, the participants are design students, leading the results cannot be generalized to nondesign background people. Future studies are recommended to involve the people with different background. Additionally, the emotions and associations collected in the current study are suggested to apply to Kansei design, making the ecological design more emotional.

## 6. References

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