

# How Environmental Attitude Affects the Consumers' Tolerance of Paper Colors

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**Abstract:** In this study, the consumers' tolerance of accepting colored paper was investigated in order to find out how much influence environmental attitude has on color tolerance. Surveys were conducted that asked about the border colors the participants could tolerate as colors of paper dichotomously varied by three contextual variables, such as intention, usage, and recycled status. For color stimuli, 266 samples were collected and displayed in A2 size paper. Based on the participants' assessments, four trends were identified in terms of hue category, intention, usage, and recycled status. For the second part of the study, the participants' environmental attitudes were assessed by facilitating EAI-24[1]. The individual's attitude toward environment was quantified in aspects of Preservation and Utilization. However, neither qualitative nor quantitative analyses provided any evidence to support our hypothesis that the attitude toward environment would affect consumers' tolerance of paper colors.

**Key words:** *Paper Template, Guides, instructions, author's kit, conference publications.*

## 1. Introduction

Since consumers' awareness of environmental sustainability has increased, their psychological, as well as behavioral, attitudes towards recycled materials have also been found to be more positive than ever. Accordingly, a great number of recent studies have focused on the psychology of environmental attitudes, while other studies have revealed certain behavioral characteristics (e.g.[2]). For example, consumers appreciate companies that replace materials with recycled ones, and companies that aggressively advertise their environmental stances, respectively [4, 5, 6]. Considering that recycled material should be, in general, a lower quality, consumers with a higher environmental attitude are more ready to forgive any "inappropriate" qualities, as long as those qualities are not that drastic, accordingly. From this context, the study intended to investigate the consumers' tolerance of inappropriate visual quality, which should be larger when they deal with recycled material. Admitting that this tolerance should be the result of one's positive attitude towards the environment, the degree of tolerance should also be positively correlated with the seriousness of one's attitude towards the environment. Therefore, this study aimed to find out whether this effect exists, and if so, how one could characterize that effect. By understanding that the consumers' green-attitude affects their acceptance of recycled material, the study particularly focused on

the consumers' readiness to accept colored recycled paper. Additionally, the study tried to demonstrate that the individual's involvement in environmental issues could also be an influential factor.

## **2. Goal**

This study intended to identify the colors of paper that consumers would be tolerant of and to find out whether the awareness of recycled material would affect this tolerance. Moreover, the study tried to show the relationship between the individual's environmental attitude and their attitude toward colored paper, and particularly, whether a positive correlation exists between the two attitudes.

## **3. Method**

In order to provide the empirical evidence, an experiment was planned that consisted of two phases: In the first phase, a color palette was prepared that was made up of 266 color samples. The participants were asked to select acceptable colors that can be used as colors for paper. The experiment was set up so that premised that eight different conditions were varied with three contextual variables, which were 1) the usage of the paper (as office paper versus workbook paper), 2) the purpose of the paper (to use versus to buy), and 3) the recycled status of the paper (the paper's 1st use versus the paper's 2nd use). In the second phase, a paper-pencil survey was used to find out each participant's environmental attitude.

## **4. Experimental Procedure**

### **4.1 Participants**

30 students were recruited for this study. The students were made up of 10 males and 20 females, with an average age of 20.83 (Standard Deviation=1.72). All participants were majoring in Industrial Design at KAIST in Daejeon, South Korea.

### **4.2 Materials**

#### **4.2.1 Phase 1: Selection of Acceptable Colors**

The colors were selected based on the RGB structure. Since very vivid colors could not be accepted as paper colors due to bad legibility, the study began with red (150/0/0), green (0/150/0), and blue (0/75/150). Gray (75/75/75), yellow (150/112/0), orange (150/75/0), and purple (150/0/150) were also added since these colors are commonly used as colored paper on the market. Consequently, there were six hue categories and one neutral or achromatic category. Then, each hue category was expanded to three levels by de-saturating the colors. For example, grayish red (150/75/75) and more grayish red (150/112/112) were added. At the same time, 12 between colors, between the selected colors and white, were created. As illustrated in Figure. 1, 42 colors were generated,  $3 \times 14$ , starting from the red (150/0/0). Subsequently, a color palette was composed that consisted of 266 previously selected color samples. As depicted in Figure. 1, the color samples are arrayed in terms of their hue categories (19 columns on X axis) and of their White Index (14 rows in Y axis). According to this order system, the color samples with WI=14 across the entire hue categories correspond to white. Since the RGB values of the color will appear strongly based on the type of printer used, the color values were measured, such as CIELab, from each color sample after the palette was printed.

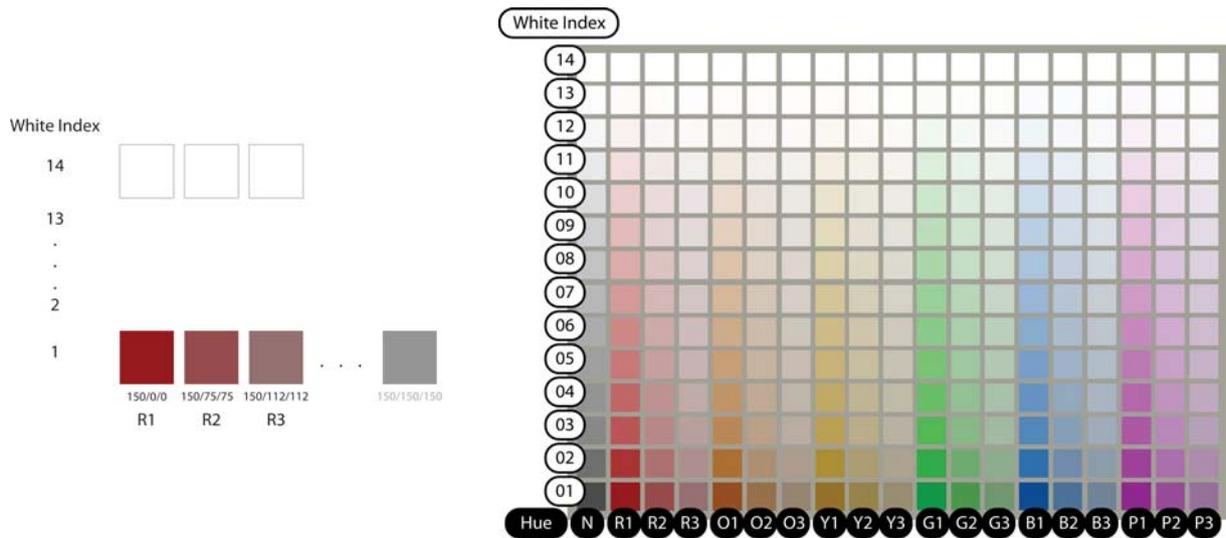


Figure. 1 The system of color palette that was printed in DIN A2 format. The color palette contains 266 color samples that are arrayed with 19 columns and 14 rows (labeled as White Index).

#### 4.2.2 Phase 2: Assessing the Environmental Attitude

In order to assess the participants' attitude toward environmental issues, a brief version of the Environmental Attitudes of Inventory (EAI-24 hereinafter), which was developed by Milfont and Duckitt [1], was used. The EAI-24 contains 24 statements and its structural model hypothesizes that first, the responses to EAI-24 are explained by twelve first-order factors, and two second-order factors. In Figure. 2, the twelve first-order factors are sorted into two second-order factors. Therefore, the 24 scales of the EAI-24 are converged into twelve first-order factors, as well as two second-order factors. For example, the two questions "I really like going on trips into the countryside, for example to forests or fields" and "I think spending time in nature is boring (to be reverse coded)" are asking about a person's "Enjoyment of nature", which belongs to the "Preservation" aspect of the environmental attitude. The participants indicated to what extent, ranging between 1 (strongly disagree) and 7 (strongly agree), they agree or disagree with each of the 24 statements. The scales are presented in random order.

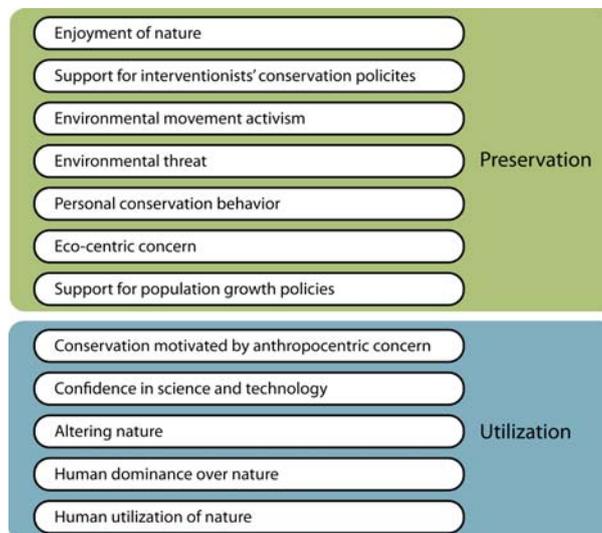


Figure. 2 The structural model of EAI-24

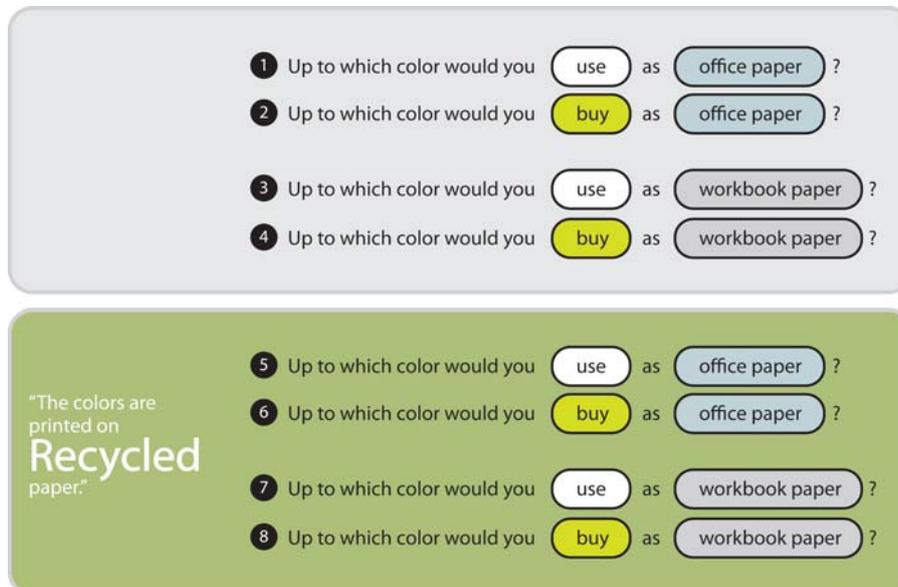
### 4.3 Procedure

In Phase 1, the participants were seated in front of a light box (BoTech Super Light VI) that created a daylight condition, D65 (Figure 3). An experimenter prepared each color to be a thumbnail of a much larger paper, such as an A4 size paper that is commonly used in offices.



Figure 3. D65 generated by BoTech Super Light IV

Then, the experimenter prepared the eight conditions to dichotomously vary the three contextual variables, such as “intention (use versus buy)”, “usage (office paper versus workbook paper)”, and “recycling status (no comment versus recycled)”. The eight instructions are presented in Figure 4, and after the fourth instruction, the experimenter pretended to confess that the color palette would have been printed on the recycled paper. After answering each question, the participant pointed to a color from each column, meaning that he or she would accept the color and the other lighter colors above. After a short break, the participants answered the EAI-24.



1 Up to which color would you use as office paper ?

2 Up to which color would you buy as office paper ?

3 Up to which color would you use as workbook paper ?

4 Up to which color would you buy as workbook paper ?

5 Up to which color would you use as office paper ?

6 Up to which color would you buy as office paper ?

7 Up to which color would you use as workbook paper ?

8 Up to which color would you buy as workbook paper ?

"The colors are printed on Recycled paper."

Figure 4. The eight instructions that varied the three contextual variables: intention, usage, and recycled status

### 4.4 Results and Analysis

#### 4.4.1 Results and Analysis 1: Phase 1

Based on the participants' WI ratings, reliability tests were conducted in order to make sure whether all the participants responded in a similar fashion. Cronbach's alphas, known as the reliability coefficients, were

calculated on the 19 hue categories, and are presented in Table 1. These results provide a satisfactory level of internal consistency ( $\alpha > 0.70$ ).

Table 1. Reliability coefficients (N=30)

Inst	Instruction							
	1 2 3			4	5 6 7			8
N of items = 19	0.99 0.	98	0.98 0.	98	0.99 0.	99	0.98 0.	98

Then, the means of the White Index (WI) were investigated across the nineteen hue categories, and are shown in Figure. 5. The WI mean values that are the result of the eight different instructions are illustrated across the entire hue categories.

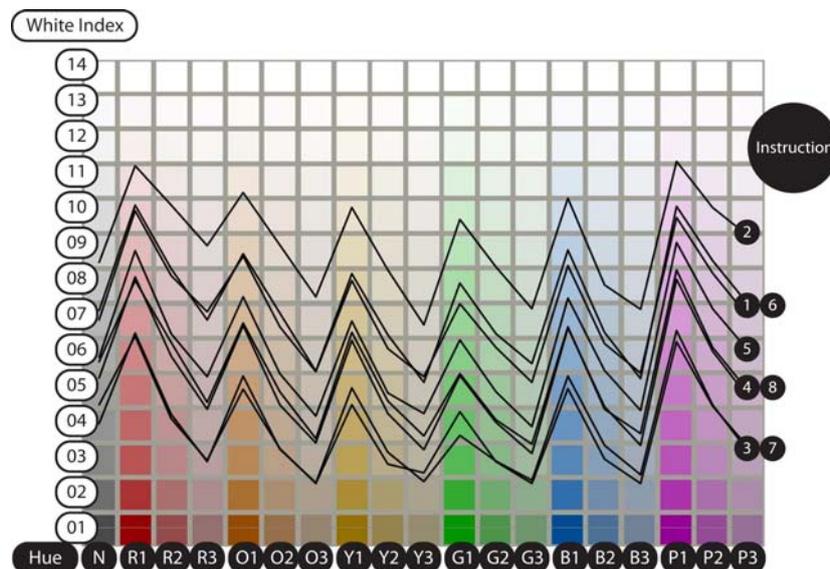


Figure. 5 A line chart that illustrates the mean values of the White Indices (WI) across 19 hue categories. The separate lines correspond to one of the eight instructions (N=30).

Since the maximum value of WI, 14, corresponds to the color white, the smaller mean values indicate that the participants were ready to accept saturated color samples as color for the paper. For example, when the hue categories are compared, the WI mean values in the “Y1~Y3” columns are always smaller than those in the “R1~R3” columns. This explains that consumers would be more tolerant with yellowish colors than with reddish colors. As another example, when the different instructions are compared, the WI mean values of even numbers (instruction number: 2, 4, 6, and 8) are bigger than those of odd numbers (instruction number: 1, 3, 5, and 7). This tells us that consumers would be more stringent with saturated colors when they buy the paper than when they just use them. In this way, the three contextual variables, such as “intention (buy versus use)”, “usage (office paper versus workbook paper)”, and “recycled status (not necessarily recycled versus recycled)” might have influenced the participants on their assessments. In order to examine the effects of each contextual variable, as well as any interaction effects that caused the combinations of the variables, a Within-Subject ANOVA was performed on these three factors. As shown in Table 2, the effects of each of the variables were always significant over the entire hue categories while we hardly find any interaction effects. Consequently, the focus became on withdrawing the assessment trends that predict whether consumers would be more tolerant with saturated colored paper that was caused by each of the three main effects.

Table 2. Significance Values (p) that resulted from a Three-Way ANOVA: with Repeated Measurements (N=30)  
 \* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

Variable(s)	Hue categories																		
	N	R1	R2	R3	O1	O2	O3	Y1	Y2	Y3	G1	G2	G3	B1	B2	B3	P1	P2	P3
Main effect of “intention”	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Main effect of “usage”	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
Main effect of “recycled status”	***	**	***	**	*	**	**	**	**	*	**	**	**	**	*	*	**	*	**
Interaction effect of “intention * usage”	0.92	0.17	0.60	0.33	0.53	0.47	0.20	0.64	0.76	0.24	0.94	0.26	0.14	0.20	0.66	0.38	0.07	0.32	0.82
Interaction effect of “intention * recycled status”	0.38	1.0	0.30	0.55	*	0.09	0.12	0.02	*	0.19	0.73	0.20	0.19	*	0.09	*	*	0.17	0.07
Interaction effect of “usage * recycled status”	0.06	0.05	**	0.01	*	*	**	**	**	0.15	*	**	***	**	*	*	0.08	0.03	*
Interaction effect of “intention*usage*recycled status”	0.27	1	0.41	0.85	0.82	0.66	0.18	1	0.81	0.35	*	0.30	0.95	0.81	0.58	0.55	1.00	0.48	0.13

With the hue categories, the four following conclusions were obtained (1) - (4).

- (1) In terms of hue: [less tolerant] purple, red < orange, blue < yellow, green, gray [more tolerant]
- (2) In terms of intention: Consumers would use colored paper whereas they would not buy it (Figure 6).
- (3) In terms of usage: Consumers would use colored paper for taking notes, but would not use the colored paper in the office (Figure 7). Moreover, among the three contextual variables, “usage” seems to have caused the biggest impact on the participants’ assessments since the difference between the two lines in Figure 7 are larger than the others.
- (4) In terms of recycled status: Consumers would use colored paper when they are aware of using recycled paper (Figure 8). The difference is, however, rather smaller than anticipated.

In addition, it was discovered that the individual differences in accepting certain colors of paper are remarkably high. In particular, some participants were more stringent in accepting colors than others were during the experiment. On the other hand, some participants were always more willing in accepting saturated colors of paper. In this study, it was hypothesized that the individual’s attitude towards the environment would affect his or her tolerance of the color of paper. Therefore, in the next section, we tried to find out whether this consumer segmentation is related to one’s attitude towards the environment.

#### 4.4.2 Results and Analysis 2: Phase 2

In Phase 1, it was noticed that the participants generally followed the four trends, but at the same time, the difference of the individual’s color tolerance was remarkably high. In other words, the participants were grouped depending on how stringent or accepting they are towards paper with different colors. Thus, in Phase 2, as was hypothesized, we tried to investigate whether the individual differences are related to his or her attitude towards the environment. According to our assumption, a person with a great concern about environmental issues could be more accepting towards saturated colors of paper since they are aware of the environmental damage caused during the paper bleaching process.

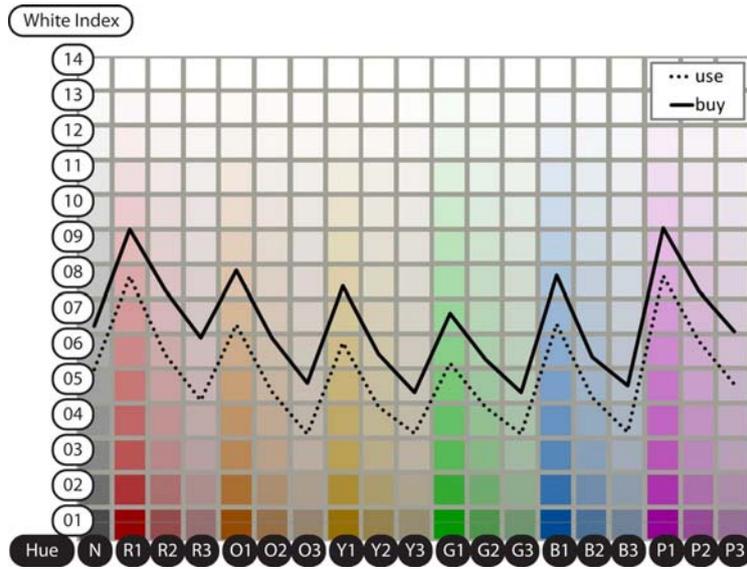


Figure 6 Averaged White Indices (WI) varied by intention: “use” (dotted line) versus “buy” contexts (N=30).

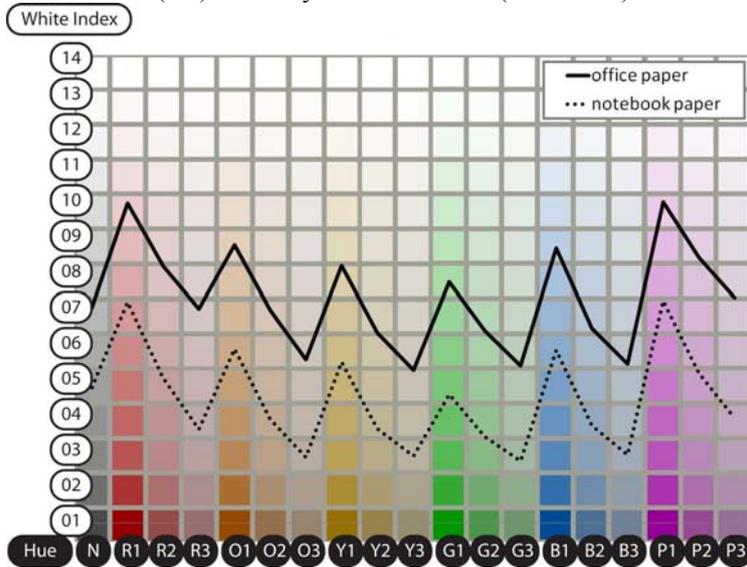


Figure 7 Averaged White Indices (WI) varied by usage: “office paper” versus “workbook paper (dotted line)” contexts (N=30).

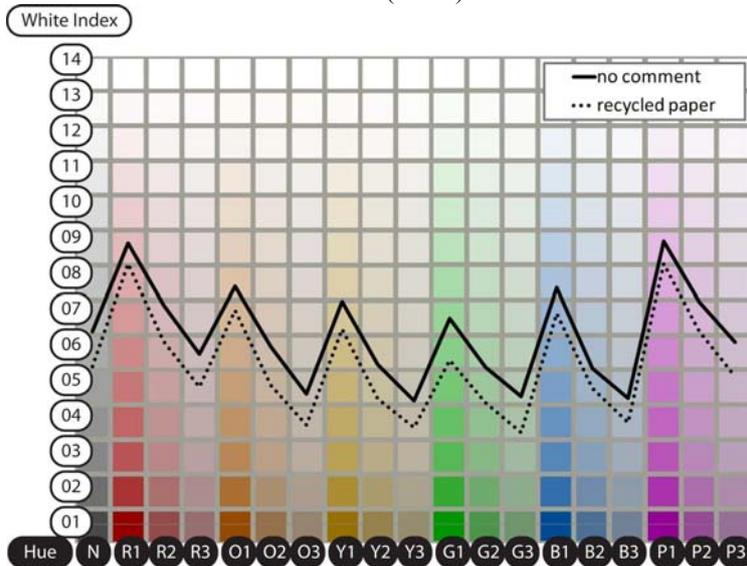


Figure 8 Averaged White Indices (WI) varied by recycled status: “not necessarily recycled (no comment)” versus “recycled (dotted line)” (N=30).

At first, we tried to figure out the clusters of them in terms of their color tolerance. Therefore, the WIs of each participant were averaged across the entire hue categories, as well as the eight instructions, so that the individual's representative WIs could be identified, which ranged between 1.97 and 9.37. Moreover, a mean value of the seven "Preservation" related ratings was calculated, as well as five "Utilization" related ratings of each participant. Based on these mean values, the 30 participants were distributed in a co-ordination that is horizontally defined by "Preservation" and vertically defined by "Utilization". As depicted in Figure 9, each dot (each participant) was labeled with the individual's representative WIs. Some dots were colored in green (when the individual's representative WIs were smaller than 5) or in orange (when the individual's representative WIs were bigger than 7). However, neither green dots nor orange dots were clustered at a certain position, but instead, they were rather widely distributed. It is still hard to make any patterns based on these results.

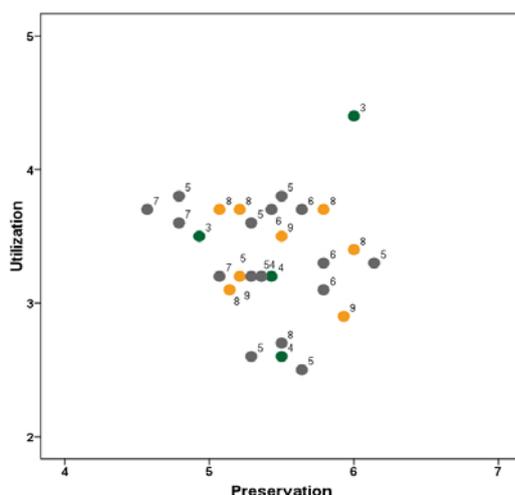


Figure 9 The 30 participants in co-ordination defined by Preservation (X axis) and Utilization (Y axis), and dots are labeled based on the individual's representative WIs (rounded at the first decimal).

Plots in green: the participants who were flexible with colors of paper (WI<5)  
 Plots in orange: the participants who were stringent with colors of paper (WI>7)

Then, we tried to find any influence of attitude on the environment by assessing the colors of paper that were the focus of each instruction. Thus, correlation analyses were conducted, so that we could investigate the relationship between one's attitude on the environment and the averaged WIs across the 19 hue categories. The correlation coefficients, Pearson  $r$ , were calculated, as presented in Table 3. However, except for the case between the averaged WIs, followed by the instruction 7 (to use / workbook paper / recycled), and the averaged scores of Preservation ( $r = -0.41$ ,  $p < 0.05$ , two-tailed), there was no significant correlation between one's attitude towards the environment and tolerance towards color.

Table 3. Results of Correlation Analysis between attitude towards the environment and WI (N=30), two-tailed, \*  $p < 0.05$

Averaged WI of 19 hue categories in case of the instruction	Preservation	Utilization	n
① : to use / office paper / not (necessarily) recycled	0.02	-0	.07
② : to buy / office paper / not (necessarily) recycled	0.15	-0	.05
③ : to use / workbook paper / not (necessarily) recycled	-0.16	-	0.05
④ : to buy / workbook paper / not (necessarily) recycled	-0.01	-	0.10
⑤ : to use / office paper / recycled	0.09	-0	.10
⑥ : to buy / office paper / recycled	0.12	-0	.07
⑦ : to use / workbook paper / recycled	<b>-0.41*</b>		0.17

⑧ : to buy / workbook paper / recycled	-0.23 0.	02
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Finally, we attempted to find out whether one's attitude towards the environment is related to the increase in the tolerance of the color of recycled paper. Thus, the differences of WI ( $\Delta$ WI) were collected and the WI values of instruction, 5, 6, 7, and 8 were subtracted from those of instruction, 1, 2, 3, and 4 respectively. According to the original hypothesis, the  $\Delta$ WI should be positively correlated with the Preservation score and negatively correlated with the Utilization score. However, the Correlation Coefficients that are shown in Table. 4 do not support our assumption. The analyses with workbook paper seem to have little potential, but the coefficients are not significant at a significant level of 0.05. In the discussion below, we debate why we failed to prove the hypothesis and discuss future investigation.

Table. 4. Results of Correlation Analysis between one's attitude to the environment and  $\Delta$ WI (N=30), two-tailed

$\Delta$ WI (not necessarily recycled – recycled)	Preservation	Utilization
① - ⑤ : to use / office paper	-0.09 0.	03
② - ⑥ : to buy / office paper	0.01 0.	04
③ - ⑦ : to use / workbook paper	0.32 -0	.25
④ - ⑧ : to buy / workbook paper	0.24 -0	.14

## 6. Discussion and Conclusion

### 6.1 Limitations of study

#### Color selection

While selecting the color stimuli, the RGB system was employed, but the RGB system does not necessarily follow human's perception of color. Moreover, the CIELab values of 266 color samples were measured after they were printed and we admit that the color management was imperfect. In this study, participants' assessments were analyzed based on the White Index, WI, which indicates the level of white that varies between 1 and 14 (WI=14: white). In a future study, a color palette needs to be composed that follows human perception.

#### Measurement of individual's attitude toward environment

In this study, EAI-24 [1] was facilitated to measure the individual's attitude towards the environment. Consisting of only 24 scales, EAI-24 provided scores of the Preservation and Utilization aspects of a person. However, we failed to identify any trends based on the participants' EAI-24 rating, and consequently, we did not find any influence of one's attitude on the environment on the participants' tolerance of colors of recycled paper. Basically, it is accepted that our hypothesis was not supported, but we also question whether the questionnaire was appropriate for asking Korean students about their attitude towards the environment.

### 6.2 Consumers' tolerance of paper colors and the influence of environmental attitude

As was hypothesized, the three contextual variables (intention, usage, and recycled status) indeed influenced the participants on their tolerance of colors of paper (Three-Way ANOVA,  $p < 0.05$ ). As illustrated in Figures 6, 7, and 8, ~, the three variables brought about clear distinctions. Particularly, four trends were identified to predict the consumers' tendency of accepting the color of paper, in terms of the three contextual variables and hue categories. As shown in Section 4.4.1, the consumers' judgments for acceptable colors of paper are more tolerant, 1) when they use the paper than buy the paper, 2), when they consider the paper as workbook, they have a larger

tolerance of the color of paper than when the paper is office paper, and 3), when they are aware of using or buying recycled paper, their tolerance of color of paper increases. Among the three variables, usage created the biggest difference whereas recycled status created the smallest. Although the influence was statistically significant, the impact was smaller than anticipated. Lastly, it was observed that the participants are more tolerant with some hue categories, such as yellow, green, and gray, while they are less tolerant with others, such as red and purple. In addition, despite the high level of internal consistency among the participants, it was recognized that the individual differences were remarkably high. This implies that the participant's ratings basically followed the four trends, but some applied very stringent or a very open perspective to all of hue categories, as well as to the eight instructions. We tried to find out on what caused the individual differences and, as was hypothesized in this study, investigated whether one's attitude towards the environment would have an influence on that. The EAI-24 was facilitated to quantify the individual's attitude towards the environment (i.e. preservation and utilization score). Based on that, correlation analysis was conducted several times. However, we have not been able to explain the relationship between the consumers' attitudes towards the environment and their tolerance of colors of paper. Considering that the influence of contextual variable, such as "recycled status", on the participants' tolerance of color of paper was significant, it basically supported the belief that consumers apply more generous criteria in assessing visual quality of recycled material. Although the question whether a consumer's attitude towards the environment would affect his or her acceptance of color of paper was not answered in this study, we expect to demonstrate the relationship between the consumers' concerns about environment and their tendency to pick colors by applying more appropriate stimuli and measurement tools.

## 8. Acknowledgment

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