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The Effect of Pastel Colors on Interior Elements of the Dental Examination Room on Children's Psychology

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Abstract. Color in the interior is one of the factors that affect the emotional condition of children. There are several types of color groups with different characters and influences on human emotions, one of which is the pastel color group. This study aims to determine the effect of pastel colors on the interior of children's emotions and the application of the right pastel colors according to children's preferences in the pediatric dental examination room. This study used a mix-methods exploratory sequential approach in the form of visual experiments by presenting 4 space simulations with monochromatic pastel color compositions of red, blue, yellow, and triadic colors of the three as well as 1 control room. Respondents are students of the Abdurrahman bin Auf Homeschooling Group in Cibinong with an age range of 4-8 years. All data were analyzed through correlation test methods, T-test, and ANOVA. Results identified that children tend to like the basic colors found in the rainbow to be applied to the dental clinic, there are differences in assessment based on education level. This is due to children with higher levels being more able to judge based on visual perception of their environment so that they have stronger color preferences.

Keywords: *children emotion; interior; pastel color; dental examination room.*

1 Introduction

According to Atwater (1983) quoted from Pratiwi and Budisetyani [1], emotions arise in individuals due to a stimulus in the environment that is received by the senses. Likewise, what happens to children, the emotions that arise in them are caused by the stimuli in their environment. One example of such a stimulus is color. In their daily activity, children are always exposed to color through various objects such as the things they have, the food they eat, and the room they occupy.

The colors found in the environment such as in interior spaces can have a certain effect on their emotional state, including providing calm, joy, increasing anxiety, tension, and others. For example, Harini [2] mentions that green colors can have a calming effect, bright colors such as red and yellow affect joy, and dark colors

such as black or brown give the effect of anxiety and sadness. In a study conducted by Diette et al. [3], Eisen [4], and Schneider et al. (2003) in Hathorn [5], explained that images of natural landscapes such as forests and nature scenes with a color composition dominated by green and blue are considered to have a positive effect on the patient's feelings, such as feeling calm, relieving stress, reducing stress, releasing anxiety, even makes a person able to control his emotions. Previous studies have shown that children prefer bright colors to dark colors. However, according to June McLeod in Abbasi [19] babies and children prefer to be surrounded by soothing pastel colors. This is because pastel colors affect the atmosphere of the room to be calming and comfortable.

Currently, it is not uncommon to apply color to interior spaces without considering the effect that color will have on room users, in this case, the dental treatment room. In the dental treatment room, children are directed to feel calm and comfortable to facilitate the examination process. Therefore, the researcher wanted to analyze pastel color preferences for pediatric dental treatment rooms. It is important to understand the effect of color on children's emotions, to determine and apply the right color composition to the interior space so that it can have a positive effect on children.

1.1 Formulation of the Problem

Based on the description of the background above, the problem can be formulated as follows:

1. How does the application of pastel colors in children's environment affect their emotions?
2. What pastel colors are suitable to be applied to the dental examination room to provide a sense of calm and reduce anxiety?

1.2 Scope of Problem

For this research to be more focused, several things are limited, including:

1. The subjects studied were children aged 4-8 years who were divided into two age groups, namely 4-6 and 7-8 years.
2. The interior room that will be identified is the dental clinic examination room.

1.3 Objective Study

Based on the background and problem formulation that has been described, the objectives of this research are:

1. Can understand the effect of pastel colors on children's psychology, especially children aged 4-8 years.
2. Can identify pastel colors and the right composition to be applied to the dental clinic examination room.

1.4 Literature Review

1.5 Emotions in Children

According to Mashar [6], it turns out that there is another side that is no less important in children's development, namely emotions. Emotions in children are considered unique. This can be seen from one of the emotional characteristics in children, namely several different emotional patterns shown by the same behavior, Hurlock [7]. Children's emotions generally consist of anger, fear, joy, sadness, jealousy, affection, curiosity, and envy which are expressed with the same expression, Pratiwi & Budisetyani [1]. Emotions are divided into positive emotions, namely joy, excitement, and surprise, and negative emotions, that as anger, sadness, fear, and disgust. Positive emotions are often associated with bright colors and negative emotions are associated with dark colors. The role of emotions in children is one form of communication so that children can express all their needs and feelings to others and play a role in influencing the personality and adjustment of children to their social environment, Pratiwi & Budisetyani [1]. According to (Suriadi & Yuliani, 2006) quoted by Dewi, et al., [8] At the age of 7-8 years, children already understand the shame and pride of something and children can express the emotions they feel.

1.6 Color

Color can be interpreted as a visual language that can provide a picture or reflection of mood and represent emotions. There are a wide variety of colors with varying effects on a child's emotions. The emotional effects on children that can be caused by color in interior spaces include providing calm, and joy, and increasing anxiety, tension, and others. In a clinical context, the use of color can assist intervention by activating and promoting positive emotions, which can then have a higher therapeutic and preventive effect and which can ultimately increase motivation to heal, Izard (2002) quoted by Pope, et al [9]. Color can also be used as an accepted therapeutic tool with various medical applications, Babu, et al [10].

1.7 Color Types

The famous physician and mathematician Sir Isaac Newton, through his experiments, designated the seven colors reflected from a prism on a white panel as the Visibile Specture. The colors are red, orange, yellow, green, blue, indigo, and purple, Zelanski & Fisher [11]. In nature there are three basic colors, there are red, yellow, and blue. Another classification for color is based on the effect color has on humans, namely cold and warm. Warm colors are red, orange, and yellow, while cool colors are blue, green, and purple. (Artut, 2004) quoted from Çiçek [12]. Warm colors usually have the effect of liveliness, excitement, and action. Cool colors are more about calm, comfort, and relaxation (Altınçekiç, 1994) quoted from Çiçek [12]. Color luminance can be increased by adding white and lowered by adding black. The addition of white gives rise to light colors or so-called pastel colors, Sari [13]. This color type has a bright character but the color intensity is not so strong because it is mixed with quite a lot of white.

1.8 Interior Color

Color is one aspect that can liven up or create an impression in a space. John Pile says that the use of color is the main focus in interior design and is also an important factor in determining the success of a project [14]. In addition, the color in the interior also has the ability to affect the function of the body, mind, and human emotions when they are in the interior space. One of the ways to get a positive atmosphere and impression is by composing the right colors on the interior elements of the room. Improper application of color can cause uncomfortable feelings and can even have a negative impact on a person's psychology. For example, applying the color composition to images posted in the pediatric inpatient room in Hathorn & Nanda's research [5] can improve children's mood based on their preferences.

Figure 1. The highest rating image. (Source : Hathorn & Nanda, 2008).

2 Experimental Method

The method that is used in this research is a mix-methods exploratory sequential which prioritizes qualitative methods such as literature study, observation, and interviews with participants. Then it is connected with processing data from the questionnaire quantitatively through a comparative test (t-test) and correlation to analyze the results and get conclusions from the research.

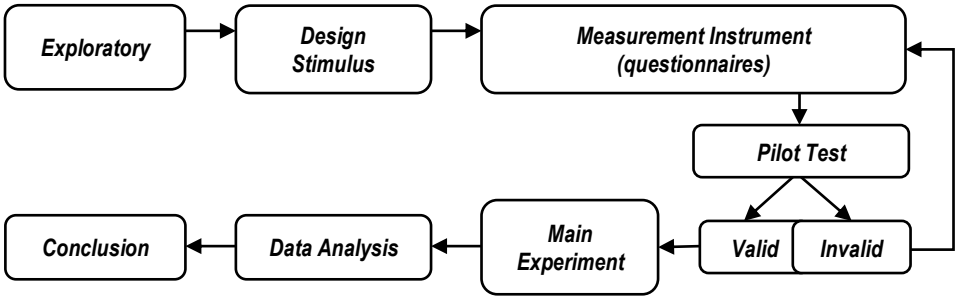


Figure 1. Experimental method step. (Source: Pramesti, Ashri)

2.1 Experimental Design

This research uses mixed methods to get a comprehensive understanding and results from the aspects studied. Exploratory deepening was carried out to find research variables, starting with literature studies and observation as the basis for research, then designing stimulus based on the results of literature studies. In this case, pastel colors act as independent variables so that this aspect manipulates the interior elements of the children's dental clinic through 3D Modeling. Followed by formulating a questionnaire related to emotional state, attitude, and perception response as the dependent variable. Pilot tests were conducted on respondents to obtain the validity of the stimulus and questionnaire designs as well as an overview of effective procedures in terms of duration. All data will be processed in the form of statistical data through the SPSS program for further correlation tests, t-tests, and ANOVA.

2.2 Experimental Preparation, Stimulus, and Equipment

In this experiment, we use digital simulation by considering the practicality and effectiveness of the experiment. The visual simulation that will be given to participants is in the form of a 3D image of a pediatric dental clinic examination room by applying two pastel color compositions in a monochrome and triadic. The dental examination room will be divided into four 3D visual simulation

conditions and one control or no stimulation condition. The four simulation conditions are distinguished based on their color composition, namely:

1. Red pastel monochromatic color composition.
2. Blue pastel monochromatic color composition.
3. Yellow pastel monochromatic color composition.
4. Triadic pastel color composition of red, blue, and yellow.

These four simulation conditions will be displayed on Virtual Reality Goggles in which a smartphone is installed which will show a visual simulation of the dental examination room with sequential conditions starting from the control conditions, followed by monochromatic color composition until finally the triadic color composition.

(a) (b) (c)

Figure 2. *Range* schematic red pastel(a), blue pastel (b), and yellow pastel (c). (Source : ww.w3schools.com)

Pre-test: Control Condition

Participants were given a children's dental clinic examination room with color conditions and layout arrangements as in the existing one without the addition of color stimuli to the interior elements. This room is used to get the concentration comparison data before and after the test.

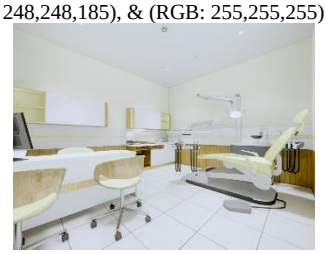
(c)

Figure 3. Condition of pediatric dental clinic control. (Source :Pramesti)

Post-test: Virtual Environment

A simulation in the form of a pediatric dental clinic examination room with cool daytime lighting and the application of pastel colors to the composition of monochromatic and triadic schemes as a stimulus, made in the form of 3D images using the Sketchup program and rendering using the Enscape program. The color schemes applied to these images have been determined based on some of Mussel's color harmony principles. The color specifications for each scheme are taken from www.w3schools.com, with explanations and views as follows.

Table 1 Color scheme in visual experiment room simulation.

<table>
<tr><th colspan="2">Dental Examination Room</th></tr>
<tr><td>Wall (RGB: 253,234,232), (RGB: 243,144,135), (RGB: 255,255,255)
Floor (RGB: 255,255,255)
Ceiling (RGB: 255,255,255)
Furniture (RGB: 248,191,185), (RGB: 244,148,139), & (RGB: 255,255,255)
 
Figure 4 Red pastel monochromatic room. (Source: Pramesti)</td><td>Wall (RGB: 232,237,253), (RGB: 116,149,241), & (RGB: 255,255,255)
Floor (RGB: 255,255,255)
Ceiling (RGB: 255,255,255)
Furniture (RGB: 162,184,246), (RGB: 209,220,250), & (RGB: 255,255,255)
 
Figure 5 Blue pastel monochromatic room. (Source: Pramesti)</td></tr>
<tr><td>Wall (RGB: 253,253,232), (RGB: 246,241,166), & (RGB: 255,255,255)
Floor (RGB: 255,255,255)
Ceiling (RGB: 255,255,255)
Furniture (RGB: 246,241,166), (RGB: 248,248,185), & (RGB: 255,255,255)
 
Figure 6 Yellow pastel monochromatic room. (Source: Pramesti, Ashri)</td><td>Wall (RGB: 253,253,232), (RGB: 251,251,208), (RGB: 243,144,135) & (RGB: 253,253,232)
Floor (RGB: 255,255,255)
Ceiling (RGB: 255,255,255)
Furniture (RGB: 162,184,246), (RGB: 244,148,139), & (RGB: 244,148,139)
 
Figure 7 Triadic pastel room. (Source: Pramesti, Ashri)</td></tr>
</table>

2.3 Participants

Research participants were selected from the Abdurrahman bin Auf Homeschooling Group in Cibinong with the criteria of age 4-8 years which were divided into two age groups, namely 4-6 and 7-8 years. The first group consisted of 4 girls and 4 boys, but one boy was invalid because he did not follow the procedure completely, the second group consisted of 2 girls and 5 boys, the total respondents were 14 children. The age range was chosen to see if there was a difference between the two groups when given a stimulus. The selected participants had a normal color vision. In addition, there is no physical or mental condition that can prevent them from participating. As a sign of gratitude, respondents were given a gift containing various kinds of snacks.

2.4 Measurement

To identify the effect of a given color stimulus, a questionnaire was created using a graphic rating scale. 4 emotional variables use 3 emoticon images as a simple size scale that is easy for children to understand.

Table 2 Emotional Scale.

Emotion Scale	1 	2 	3 
Children's Dental Examination Room			
Feeling	Sad	Neutral	Happy
Likeness	Don't Like	Neutral	Like
Braveness	Not Brave	Neutral	Brave
Willingness	Don't Want	Neutral	Want

(Source: Pramesti)

2.5 Experimental Procedure

The experiment was carried out for two days, the first day the experiment was carried out by the 4-6 year age group, and on the second day by the 7-8 year age group. This is done so that the implementation time is not too crowded and participants are not in a hurry to observe the simulation room. The experiment was carried out in a classroom in a sitting position. They were told the purpose and direction of the experiment. Then a visual simulation was carried out using VR Goggles worn by the participants. Each participant was asked to rate the control condition room and 4 rooms with a pastel color composition stimulus. Participants were allowed to move their heads in various directions to get a comprehensive visual experience and were asked to share their feelings when

observing these spaces. Each image is displayed for 1-2 minutes. After the experiment was completed, a questionnaire was given by showing the 5 pictures of the simulation room on A5 paper. Children are guided by a friendly and interactive approach, to make it easier and more comfortable for children to make assessments.

3 Result

The correlation test was conducted to determine the effect of the stimulus on the elements of the examination room on the psychological state of the respondents. In this case, there are 4 color composition variables and one control condition. The results of data processing show the correlation coefficient values of the five rooms which are similar to each other, as shown in table 3. While whether or not a strong relationship can be known from the value of the correlation coefficient (Table 4).

3.1 Correlation analysis

Table 3 Correlation test results of the pediatric dental clinic.

	Pre-Test	Mono Red	Mono Blue	Mono Yellow	Triadic
Feeling	0.831	0.933	0.763	0.767	0.857
Likeness	0.829	0.973	0.832	0.743	0.963
Braveness	0.784	0.703	0.369*	0.687	0.901
Willingness	0.899	0.916	0.906	0.914	0.871

(Source: Pramesti)

Table 4 Correlation coefficient of product Pearson moment.

Value	Correlation Coeficient
0	No correlation
0 to 0.25	Very weak
0.25 to 0.5	Enough
0.5 to 0.75	Strong
0.75 to 0.95	Very strong
1	Perfect

(Source: Pramesti)

Table 3 shows the results of the correlation test in the dental clinic examination room showing similar results between the simulation rooms. The dental clinic room with a pastel red monochrome color composition has the strongest influence on each emotion variable compared to the other four rooms. The emotional

variables such as feeling happy or sad, liking the room, the level of courage to do a dental examination, and the level of their willingness to be examined. However, there is one value that does not show the significance of the effect of a room with a pastel blue monochrome composition on the respondent's level of courage, this shows that children are more stimulated by the level of the courage of the four rooms with other color compositions, such as control conditions, pastel yellow monochrome, red pastel and triadic.

3.2 T-Test

A T-test was performed using SPSS to evaluate the difference in the mean by pairing the control condition room (pre-test) with the stimulated color space (post-test) (table 6). The significance level is alpha 5% or 0.05.

Table 5 Room comparison pair for the t-test.

T-test 1	**PreTest – Mono Red**
T-test 2	**PreTest – Mono Blue**
T-test 3	**PreTest – Mono Yellow**
T-test 4	**PreTest – Mono Triadic**

(Source: Pramesti)

Table 6 Average total score of the pediatric dental clinic.

Classroom	**DP**	**DR**	**DB**	**DY**	**DT**
Mean	8.64	9.50	10.57	8.86	9.57
Standard Deviation	2.620	2.710	1.697	1.994	2.954

(Source: Pramesti)

In the results of the T-test analysis, the total score in the dental clinic room where the room with pastel blue composition has the highest average score, but the lowest average is owned by the dental clinic room with control conditions (Table 6), and the value is less than 0.05 (table 7) so that there

is a significant difference in values between the control condition dental clinic room and the pastel blue dental clinic room. This means that in the dental clinic, children tend to like rooms with shades of blue and feel anxious about dental clinic rooms that do not have color accents in them.

Table 7 Result of t-test total score of the pediatric dental clinic.

Correlation	DP-DR	DP-DB	DP-DY	DP-DT
Total Score Value	0.497	0.004	0.844	0.397

(Source: Pramesti)

3.3 Anova Test (Based on education level)

Analysis of the ANOVA test was carried out to determine the existence of a significant difference of a variable in several groups. In this case, the researcher wants to know whether there are differences in respondents' assessment and preference for color based on the respondent's education level. The first group is a Kindergarten education level with an age range of 4-6 years. While the second group is an elementary school level with an age range of 7-8 (grades 1 and 2).

Table 8 The results of the ANOVA test in the pediatric dental clinic are based on education level.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Total D-PreTest	Between Groups	37.786	1	37.786	8.817	.012
Total D-Red	Between Groups	44.643	1	44.643	10.534	.007
Total D-Blue	Between Groups	2.571	1	2.571	.885	.365
Total D-Yellow	Between Groups	28.571	1	28.571	14.815	.002
Total D-Triadic	Between Groups	7.143	1	7.143	.806	.387

(Source: Pramesti)

ANOVA analysis in the pediatric dental clinic (Table 8) shows that the control room, the composition of pastel red, and pastel yellow have significant differences. This proves that there are differences in the assessment of children aged 7-8 years who better understand their color preferences with kindergarten children who still do not have a strong color preference.

3.4 Interview Result

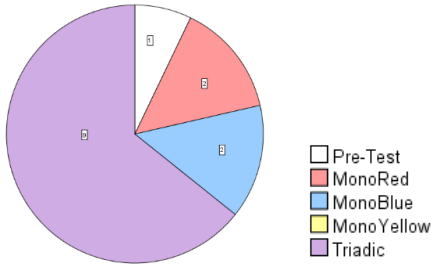


Figure 8. *Pie chart* Favorite Dental Room.
(Source : Pramesti).

Based on the results of the interviews, the researchers found different facts from the experimental process and the questionnaire, as seen from the pie chart above, the majority of respondents chose a room with a triadic color composition as their favorite exam room. From several interview questions, the researcher asked about what respondents would like to add to the interior of the pediatric dental polyclinic examination room. The result was found that most of the respondents wanted the addition of color accents or rainbow images in their room.

4 Discussion

Research related to the effect of interior color on child psychology is considered to need further study. Despite the diversity of results obtained by researchers, it is proven that the composition of pastel colors can affect emotions in children. This diversity of results is caused by the selection of respondents' age ranges that are too far apart (4-8 years). In this case, the respondents are divided into two age groups based on their level of education. The first group is children - children at an early age of development who just received information or knowledge related to basic colors with objects that are often used as illustration media are rainbows enthusiasm of children who are curious about the environment makes them easy to accept and like these objects. The second group with a slightly more mature age has been able to think more complexly and have stronger preferences, therefore they are able to express their opinion on the objects presented. Terwogft and Hoeksman [15] also found that the relationship between color and perceived emotional preferences varied according to age and gender this preference can be influenced by the experience of each individual's visual perception, Hotwani & Sharma [16]. In addition, another factor is the focus of the respondent's

distraction. The respondents are Abdurahman Bin Auf Homeschooling Group students who are very cheerful, active, and enthusiastic. Regarding the enthusiasm of the respondents, the instrument used by the researcher (VR Goggles) was something new for the children so they were more impressed with how the instrument was played. The drawback of this study is that it only uses three emotions as a measurement scale (happy, neutral, sad) that is evaluated. It would be more effective if more emotions were evaluated for better correlation. Subsequent studies with larger sample sizes and different ages, more diverse color samples, and different emotions are recommended to be able to form a strong relationship between colors and different emotions of children. This research will have important implications for people involved in the process of designing a room for children. Research results can also help healthcare providers and professionals understand which colors are appropriate for the pediatric population.

5 Conclusion

Based on the results of the analysis that has been done, the researchers found quite diverse results from each type of test. The first is in the correlation test, the data shows that the color that has the biggest influence on the dental clinic examination room on children's emotions is pastel red. This is due to the character and appearance of the strong pastel red color compared to other pastel color compositions. Then on the results of the T-test, the comparison of the control condition room with the pastel blue composition room showed a significant difference. In other words, many respondents gave a high value to a room with a pastel blue composition. Researchers concluded that pastel blue is safe to apply to the interior of a dental clinic for children because pastel blue can provide positive energy such as a sense of calm and reduce anxiety.

Furthermore, through the analysis of the ANOVA test, the researchers found that the control condition room, the composition of pastel red, and pastel yellow had significant differences. This proves that there is a difference in the assessment of children aged 7-8 years who better understand their color preferences with kindergarten children who still do not have a strong color preference. Then based on the results of interviews with respondents, it was found that respondents tend to like rooms with triadic color compositions and want to add color accents and rainbow images in their rooms.

Appreciation

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