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The Impact of Color Preference on Adolescent Children's Choice of Furniture

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ABSTRACT

It is widely believed that children will choose furniture that has the same color as their preferred color. Furthermore, for different categories of furniture, the color they preferred for furniture is consistent. A study of 508 adolescent Chinese children between the ages of 12 and 16 has been carried out to explore whether color preference influences their choice of furniture when they are provided with various color options (16 chromatic and five achromatic colors). This work tested six items of furniture in two functional spaces (study and bedroom space). Findings indicate that adolescent children's color preferences did indeed affected their furniture choice, but the extent varies with the categories of furniture. Furthermore, this study reveals that children's preference for furniture in different functional spaces is slightly different. Some effects of gender and age were also explored. This work discusses the implications of adolescent color preference and color choice for children's furniture color design.

KEYWORDS: color preference, furniture design, choice of furniture

INTRODUCTION

Color is a vital part of the product. Appropriate color can convey not only product information and features, but can also attract customers' attention,[1] stimulate their willingness to purchase,[2] and greatly improve the recognition of the brand.[3] Besides this, color can trigger cognitive task motivations,[4] stimulate emotions,[5-7] and also lead people to associate with specific words and objects.[8]

In product areas such as clothing, cosmetics, and food packaging, color forms a crucial part of the industrial design process. Enterprises need to formulate specific color design strategies for commodities.[9] Color has become a significant tool to publicize the brand. It is not only associated with brands such as Tiffany & Co's blue, McDonald's gold, Victoria's Secret's pink and so on, but also can be used as a distinguishing feature from competitors, such as Coca-Cola's red, Pepsi's blue. Also, color can be a vital selling point of products such as Apple's multi-color iPod music player, and Nike's ID sneakers for customized colors.[10] However in other product areas such as furniture, as a practical product closely related to human life, there has been little research on the color of furniture. Xu et al. conducted a series of studies on the color semantics of modern furniture. By analyzing 43 sets of color furniture pictures and 30 pairs of adjectives, they proposed a cognition space of modern furniture color semantics.[11] A related study has shown that the participants' responses to furniture color stimuli not only stemmed from the color attributes but also the cognition and experience of the furniture concept.[12] In the study of object color preference, different types of furniture were also involved, such as sofa[13,14], chair[13,14], and couch[15]. In these studies, it seems that object color preference varied with the furniture category. For instance, participants preferred red and blue hues for the couch.[15] However, for sofas and chairs, participants showed a significant preference for brown hues.[13]

As a special category in furniture, the importance of children furniture's color has been underestimated. Furniture color is an imperative part of the interior environment which plays an essential role in children's growth. A child's perception of color is keen: infants as young as three months can distinguish between yellow, red, and blue.[16] Infants between five and eight months can describe objects with the help of color[16], and children between three and four years can perceive the emotional meaning of different colors[17]. Therefore, the color of an interior environment is not only related to children's visual, perceptual and cognitive development[18] but also closely related to their emotional and physical reactions[19]. In this study, the focus is on children between the ages of 12 and 16. The rationale for this is that, according to Jean Piaget's Cognitive Development Theory, adolescent children (12 years and older)[20] in the Formal Operational Stage tend to be mature in their thinking development and can logically express their demands and views.[21-23] Learning space furniture (desk, chair, and bookshelf) and bedroom space furniture (bed, wardrobe, and bedside cabinet) have the closest contact with adolescent children in their daily lives. At present, little color research has been conducted into the color of children's furniture in these two functional spaces. Children are the users of this furniture, but the main purchaser is their parents. When choosing furniture, children's color preferences will inevitably be ignored by their parents. If adolescent children are allowed to choose furniture in their rooms, what colors would they choose?

In product design, the consumer's color preference is considered to be vital. However, whether consumers' color preferences affect their product choices remains controversial. An earlier study of automobile, clothing, and furniture has shown that consumers' product color choice was not related to their individual color preferences.[13] With the increase in the number of studies, some have found that consumers' color preferences not only affects their perception and attitude towards products but also influences purchase decisions. A study of personal-care products has shown that for toothbrush products in particular, consumers are more inclined to choose products that have the same or similar color as their individual color preferences.[24] For the automobile, a study has shown

that color preference is one of the determinants of consumers' choice. Consumers were more inclined to purchase cars that match their color preferences.[25] A recent study that focuses on household products (kitchen and bathroom) has shown that color preference is not the main factor affecting consumers' purchase decisions; color function, color performance, and color culture may be more crucial factors.[26] A study of children's learning space furniture showed that the color design of this furniture should be based on the character of children's color preference.[27] This underlines the importance of children's color preferences for furniture design. Thus, the question arises: do children's color preferences affect their furniture color choices?

Many theories have attempted to explain the origins of human color preference. Some studies indicated that such preferences are derived from the signals of biological transmission in nature[28] and the gender differences in the evolutionary division of labor.[29] Some studies have demonstrated that color preference stems from the association between color and emotion.[5-7] There have also been some studies that propose an Ecological Value Theory.[30,31]

Children's color preferences have been studied in the past, with many studies indicating that these have significant gender differences. Jonauskaite's research showed that girls prefer pink and purple whereas boys prefer red, and both genders prefer blue.[32] Cunningham SJ's research indicated that stereotypes for "color-gender" have an impact on young children's behavior.[33] Wong's research has shown that gender differences in color preferences exist between the age of two and three years, and this is strengthened after three years.[34] LoBue V's research highlighted that by the age of two, girls prefer pink objects to boys and boys increasingly dislike pink.[35] One explanation for the gender difference was that these are gradually formed. In infancy, children have no gender differences in color preference.[36] By the age of two, children are beginning to exhibit differences[37], boys increasingly like blue, green, red, black, and orange; girls increasingly like pink and red.[33] To avoid the stereotype of "feminization", between five and seven years, boys will deliberately refrain from choosing pink and red as their preferred colors.[38] This gender difference will remain until adulthood.[32] Many studies have shown that children's color preferences have significant age differences. Boyatzis's research has shown that as children grow older, girls prefer brighter colors, and boys are more likely to have positive emotional associations with dark colors.[39] Child's research determined that children's preference for high-purity color is getting lower, and the consistency of hue selection increases as age increases.[40] Mohebbi's research showed that children favor yellow as age increases.[41]

The purpose of this study is to explore whether adolescent children's color preferences affect their furniture choice under the same racial and socio-cultural background. This study also concentrates on whether gender and age affect adolescent children's color preference and furniture choice. Building on previous studies, the scope of product categories and the age range of participants were expanded.[24-26,32,34] Compared with similar studies[24,26], the color samples in this study used the NCS (Natural Color System) notation and included variations in hue, blackness, and chromaticness.[42] In addition, this study can provide a theoretical basis for furniture practitioners to understand the importance of children's color preferences for furniture design. This should also allow parents to pay more attention to their child's color preferences while they purchase furniture for them. Our hypothesis is that adolescent children's color preference influences their choice of furniture. This study discussed the influence of gender, age, furniture category, etc. on any potential relationship. The study also compared children's color preference data with existing studies.

METHODOLOGY

Participants

Participants in the study were adolescent children between the ages of 12 and 16. A total of 508 participants from Nanjing Qixia (Haimen) Experimental Middle School in Nanjing, China completed the survey (271 males, 237 females). All participants passed the Ishihara color-blindness test,[43] and none was color deficient. Guardians (parents) of all participants read the consent and agreed to let their children participate in this online survey. Table 1 summarizes the gender and age of the participant groups.

Gender	Male: 271 (53.3%)	Female: 237 (46.7%)
Age	Low grade (age≤14): 376 (74%)	High grade (age≥15): 132 (26%)

Table 1: The proportion of participant groups by gender and age.

Furniture samples

The survey used two line-drawing pictures as furniture samples, which represent the two most common environments in adolescent children's daily life: learning space and bedroom space. The learning space included a desk, chair, and bookshelf. The bedroom space included a bed, Wardrobe, and bedside cabinet. Sample images were drawn by using the Concepts app for iOS. The pictures consisted of black lines and white backgrounds (no color). In addition to the furniture above, sample pictures also contained some common elements found in children's rooms such as small flags and balls (Figure 1).

Color samples

The samples used in this research contained 21 colors (16 chromatic and 5 achromatic colors). NCS (Natural Color System) notation was used in this study.[42] This color sample was based on the NCS 1950 standard colors. The samples included four primary Hues based on Hering's color opponency theory: red (R), green (G), blue (B), and yellow (Y) and variations in hue, blackness, and chromaticness.[42] Five color groups were selected. The selection method was as follows:

- 5 colors were selected as the achromatic (A) group, white (A03), light gray (A20), middle gray (A45), dark gray (A70), and black (A90), and their blackness values separately were 3%, 20%, 45%, 70%, and 90% (see Table 2).
- 4 high chromaticness colors were selected under the four hues as the saturation (S) group. The blackness and chromaticness values of colors in the S group were 10% and 70%. Since blue and green hues have no corresponding colors (blackness value was 10% and chromaticness value was 70%) in NCS notation, colors at the nearest position were selected. In this case, the blackness value was 15% and the chromaticness value was 65% (see Table 2).
- 4 colors were selected under the four hues as the muted (M) group. Compared to the S group, color in the M group have higher blackness and lower chromaticness. The blackness and chromaticness values of colors in the M group were 20% and 50% (see Table 2).
- 4 low blackness colors were selected under the four hues as the light (L) group. The blackness and chromaticness values of colors in the L group were 05% and 30% (see Table 2).
- 4 high blackness colors were selected under the four hues as the dark (D) group. The blackness and chromaticness values of colors in the D group were 60% and 30% (see Table 2).

In this study, all descriptions and analyses used the NCS notation. Therefore, the L* values between the colors under each group in CIE L*a*b* were not identical (Table 2).

N	NAME	NCS NO.	SAMPLE	BLACK NESS	CHROMATI CNESS	HUE	L*	a*	b*
3	SY	NCS S 1070-Y		10	70	Y	80.06	1.61	80.68
14	SR	NCS S 1070-R		10	70	R	50.52	59.78	25.19
7	SB	NCS S 1565-B		15	65	B	53.66	-11.27	-36.73
19	SG	NCS S 1565-G		15	65	G	59.52	-50.14	20.18
8	MY	NCS S 2050-Y		20	50	Y	71.23	-0.45	53.94
4	MR	NCS S 2050-R		20	50	R	55.14	40.97	15.64
18	MB	NCS S 2050-B		20	50	B	57.26	-16.26	-29.94
6	MG	NCS S 2050-G		20	50	G	61.12	-42.56	13.66
17	LY	NCS S 0530-Y		05	30	Y	91.3	-2.31	41
9	LR	NCS S 0530-R		05	30	R	80.62	24.63	9.75
11	LB	NCS S 0530-B		05	30	B	81.86	-12.97	-16.11
1	LG	NCS S 0530-G		05	30	G	85.43	-26.4	10.91
10	DY	NCS S 6030-Y		60	30	Y	37.7	2.52	30.64
5	DR	NCS S 6030-R		60	30	R	24.04	26.34	10.26
20	DB	NCS S 6030-B		60	30	B	27.82	-8.8	-20
12	DG	NCS S 6030-G		60	30	G	30.05	-27.04	7.73
15	A03	NCS S 0300-N		03	00	N	96.54	-0.19	1.55
2	A20	NCS S 2000-N		20	00	N	80.6	-0.19	1.61
21	A45	NCS S 4500-N		45	00	N	58.99	-0.19	0.52
16	A70	NCS S 7000-N		70	00	N	39.43	-0.41	1.14
13	A90	NCS S 9000-N		90	00	N	9.19	-0.21	-0.87

Table 2: The NCS notation and CIE L*a*b* values of each color in the 21-color sample. In the NAME column of the table, the first letter represents the color group (S, M, L, D or A), and the second letter represents the hue (Y, R, B or G). For five achromatic colors, the second number represents their blackness value in NCS notation. N represents the color patch in the experimental interface.

The choice of whether to conduct a large-scale online survey (lack of color management) or small-scale laboratory experiments (accurate color management) was a trade-off. Since most of the electronic display devices have adopted and therefore approximate the sRGB color space, the reproduction on different display devices should be roughly consistent.[8,26] We believe that with a large enough participant population, the difference in color reproduction between different devices can be ignored. Furthermore, this online survey used different categories of colors, and so the contrast between them was relative; even if the color displayed by different devices was slightly different, the contrast between different categories of colors should always remain relatively consistent.

The survey process

In this study, two online questionnaires have constructed on a Chinese online survey website "Wenjuanxing" (www.wjx.cn).[44] The first questionnaire (n=348) was mainly responsible for collecting data about children's furniture color choice and color preference. The second questionnaire (n=160) was designed to let participants rate the preference level of the three favorite and the three least favorite colors selected in the first part. The second questionnaire was carried out 20 days after the end of the first to avoid the interference from the first questionnaire. All surveys were conducted under identical lighting conditions in the same computer classroom.

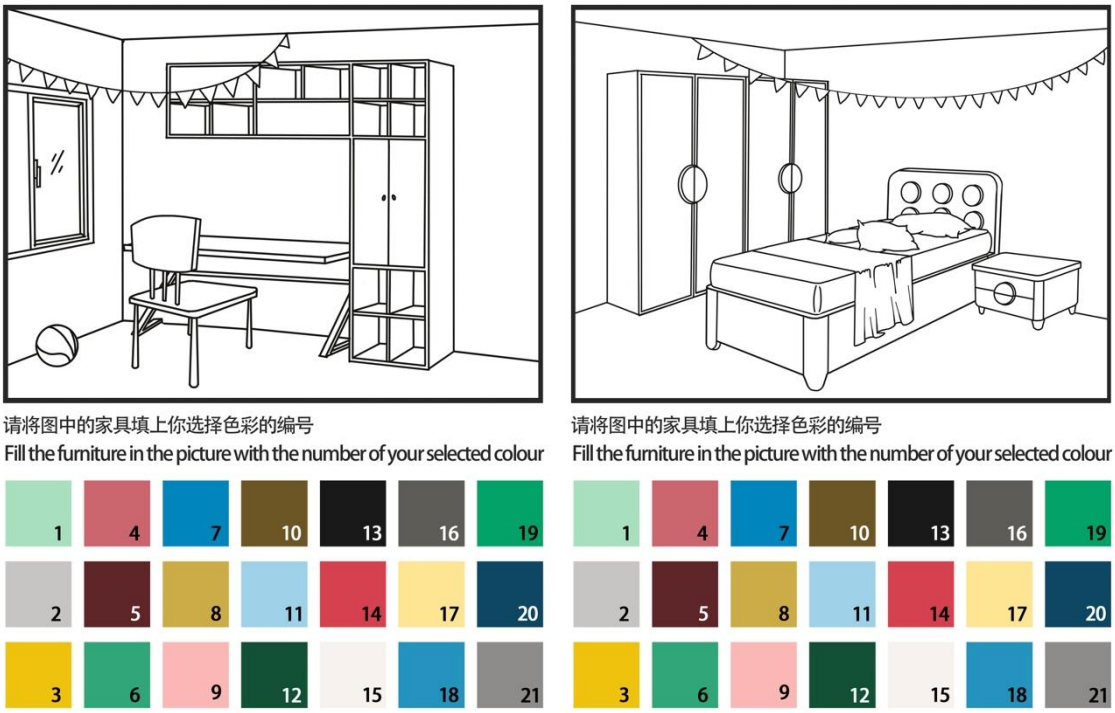

Figure 1: Pages of children's furniture color-selection. On the left is the study space, on the right is the bedroom space. All color options are random.

The first three pages of the first and the second questionnaires were the same: Page of introduction and consent: the participant's guardian (parents) should read the consent and click the "Agree" button to confirm that they agree with all contents before they let their children start the questionnaire. Page to collect each participant's name, age, gender, and grade of senior high school. Names were only used as data tags and discarded before data analysis. Page of Ishihara Color-blindness Test.[43] The results of this test have been kept confidential. Participants who failed to the test were still able to complete the questionnaire, but their data have been recorded as invalid.

From the fourth page, the first questionnaire was different from the second one. The following are specific differences:

- The first questionnaire: Pages of study space furniture color-selection (Figure 1). Participants need to select the furniture color of the desk, chair, and bookshelf from the 21-color-sets. Pages of bedroom space furniture color-selection (Figure 1). Participants need to select the furniture colors of the bed, wardrobe, and bedside cabinet from the 21-color-sets. In these two parts (pages of color choices for study and bedroom space furniture), participants need to use a drop-down box in each question to choose the number of colors they want for each furniture. The order of color numbers in every question was random. Children did not see the pictures of furniture that applied for their selected color. The color they choose only represented the color that they wanted for the furniture. Pages of preference color-selection. Participants need to choose their three favorite and least favorite colors from the 21-color-sets.

- The second questionnaire: Pages for rating color preference. Participants were asked to rate the preference for the three favorite and three least favorite colors selected in the first part (using a slidebar for scoring – see Figure 2).

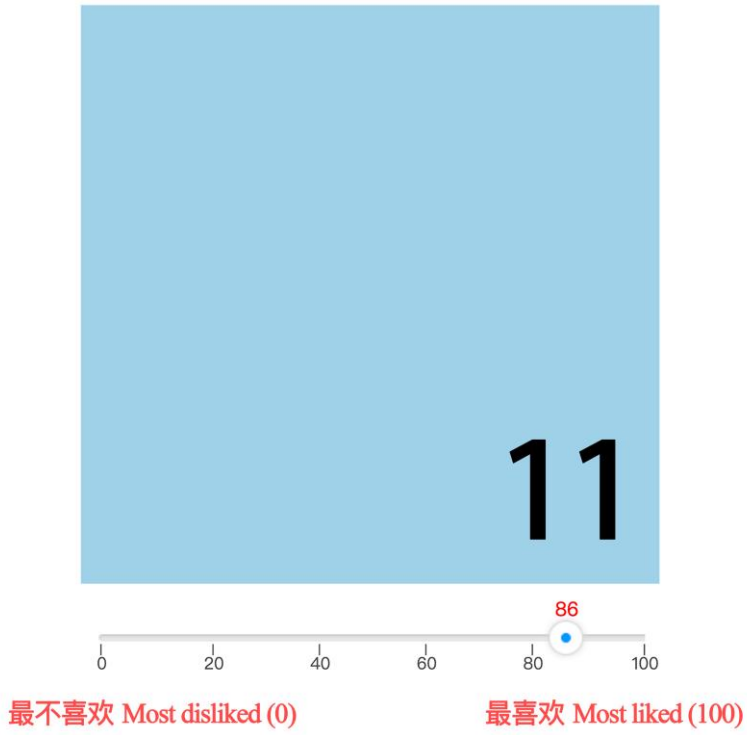

Figure 2: Page for rating color preference score (slide-bar).

RESULTS

Analysis of adolescent children's color preference

According to the three-level weight values obtained from the second questionnaire (Table 3) in different categories (S, M, L, D, and A) for color preference, adolescent children (n=348) preferred low blackness (L) and high chromaticness (S) but disliked low chromaticness colors (D). For hue, children preferred red and blue to green and yellow, especially in the low blackness group (L). Males had a greater preference for high chromaticness (S), low chromaticness colors (M) and achromatic (A) colors to females. Males also exhibited a stronger preference for blue to than did females. In the low blackness group (L), females preferred red more than males did (Figure 4).

Like/Dislike Rank	Color name (No.)	Number (n=1044)	Preference Mean Score	Weight
Most preferred color	LB-Light Blue (11)	165	61.13	1.10
Second preferred color	LR-Light Red (9)	112	58.17	1.05
Third preferred color	A03-White (15)	113	55.42	1.00
Most Dislike color	DY-Dark Yellow (10)	166	68.47	1.93
Second Dislike color	DR-Dark Red (5)	111	62.07	1.75
Third Dislike color	A90-Black (13)	81	35.39	1.00

Table 3: Total number of children, preference mean scores, and weights for the three most favorite and least favorite colors.

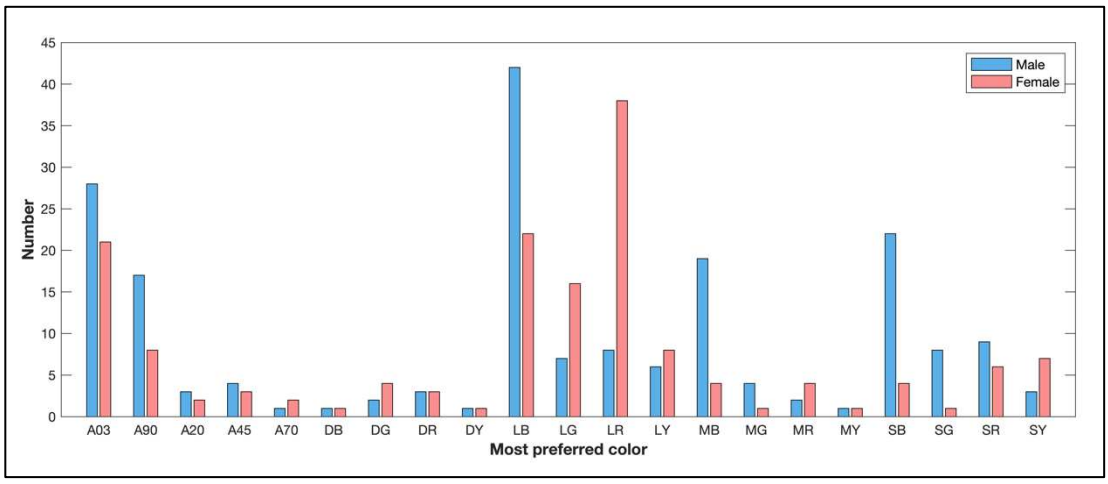

Figure 3: The gender difference in most preferred color

There was a significant color category difference between males and females in the most preferred color (χ^2=20.08, p=0.00<0.01). There was no significant color category difference between different age groups in the most preferred color (χ^2=5.67, p=0.22>0.1) (Table 4).

Color cuts		Saturation	Muted	Light	Dark	Achromatic	Total (n=348)	χ^2 (p)
Gender	Female (%)	18 (11.5%)	10 (6.4%)	84 (53.5%)	9 (5.7%)	36 (22.9%)	157	20.08 (0.00) ***
	Male (%)	42 (21.9%)	26 (13.6%)	63 (33%)	7 (3.7%)	53 (27.7%)	191	
Age	Low (≤14) (%)	43 (17%)	25 (9.9%)	113 (44.7%)	14 (5.5%)	58 (22.9%)	253	5.67 (0.22)
	High (≥15) (%)	17 (17.9%)	11 (11.6%)	34 (35.8%)	2 (2.1%)	31 (32.6%)	95	
*** p<0.01								

Table 4: Gender and age differences in most preferred color

Analysis of children's furniture color choice

There was consistency in the furniture color choices of adolescent children. In all categories of furniture, children preferred white (A03) and high chromaticness, low blackness colors (L). The most favored colors were white (A03), light yellow (LY), light blue (LB) and light red (LR) (see Table 5).

Furniture Name	The five most popular colors for each type of furniture						Total
Desk	CIE L*a*b*	15 [96.54, -0.19, 1.55]	17 [91.3, -2.31, 41]	11 [81.86, -12.97, -16.11]	8 [71.23, -0.45, 53.94]	10 [37.7, 2.52, 30.64]	348
	Children's Choice	52	40	33	31	30	
	(%)	14.9	11.5	9.5	8.9	8.6	
Chair	CIE L*a*b*	15 [96.54, -0.19, 1.55]	17 [91.3, -2.31, 41]	8 [71.23, -0.45, 53.94]	3 [80.06, 1.61, 80.68]	9 [80.62, 24.63, 9.75]	348
	Children's Choice	56	35	31	28	27	
	(%)	16.1	10.1	8.9	8.0	7.8	
Bookshelf	CIE L*a*b*	15 [96.54, -0.19, 1.55]	17 [91.3, -2.31, 41]	11 [81.86, -12.97, -16.11]	10 [37.7, 2.52, 30.64]	3 [80.06, 1.61, 80.68]	348
	Children's Choice	54	53	33	29	23	
	(%)	15.5	15.2	9.5	8.3	6.6	
Bed	CIE L*a*b*	9 [80.62, 24.63, 9.75]	15 [96.54, -0.19, 1.55]	11 [81.86, -12.97, -16.11]	7 [53.66, -11.27, -36.73]	17 [91.3, -2.31, 41]	348
	Children's Choice	63	54	53	20	20	
	(%)	18.1	15.5	15.2	5.7	5.7	

Wardrobe	CIE L*a*b*	15 [96.54, -0.19, 1.55]	11 [81.86, -12.97, -16.11]	17 [91.3, -2.31, 41]	9 [80.62, 24.63, 9.75]	8 [71.23, -0.45, 53.94]	348
	Children's Choice (%)	73	42	30	29	26	
		21.0	12.1	8.6	8.3	7.5	
Bedside cabinet	CIE L*a*b*	15 [96.54, -0.19, 1.55]	11 [81.86, -12.97, -16.11]	17 [91.3, -2.31, 41]	9 [80.62, 24.63, 9.75]	8 [71.23, -0.45, 53.94]	348
	Children's Choice (%)	63	35	28	27	23	
		18.1	10.1	8.0	7.8	6.6	

Table 5: The five most popular colors for each type of furniture, below each color there are corresponding N number and CIE L*a*b* values.

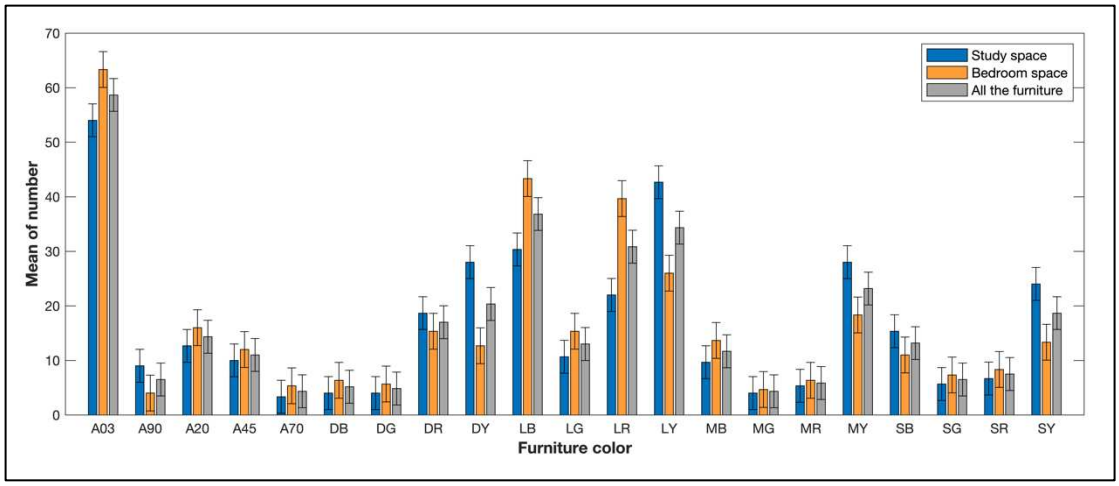

Figure 4: Color preference differences in different functional spaces and all 6 categories of furniture. The error bars represent the SEMs.

In the study space, children preferred yellow hue; in the bedroom space, children preferred blue and red hue; for all the furniture, children disliked the green (Figure 4).

Children of different genders have a significant disagreement in the color selection of furniture for the bookshelf, bed, and bedside cabinet ($p<0.01$, see Table 6). Children of different ages have no significant differences in their furniture color choice ($p>0.1$, see Table 6). Among the three categories of furniture, such as bookshelf, bed, and bedside cabinet, both males and females preferred low blackness colors (L) and achromatic colors (A). Females had a stronger preference for low blackness colors (L) than males. For the bookshelf and bed, males had a greater preference for high chromaticness colors (S) compared to females. For the bedside cabinet, males had a preference for lower chromaticness colors (M) than did females (Table 6).

Furniture Name			Saturated	Muted	Light	Dark	Achromatic	Total	χ^2 (p)
Desk	**Gender**	Female (%)	15 (9.6%)	22 (14.0%)	55 (35.0%)	24 (15.3%)	41 (26.1%)	157	**7.254 (0.12)**
		Male (%)	34 (17.8%)	25 (13.1%)	49 (25.7%)	35 (18.3%)	48 (25.1%)	191	
	Age	Low (≤14) (%)	40 (15.8%)	34 (13.4%)	76 (30.0%)	41 (16.2%)	62 (24.5%)	253	**2.700 (0.60)**
		High (≥15) (%)	9 (9.5%)	13 (13.7%)	28 (29.5%)	18 (18.9%)	27 (28.4%)	95	
Chair	**Gender**	Female (%)	18 (11.5%)	18 (11.5%)	51 (32.5%)	21 (13.4%)	49 (31.2%)	157	**8.202 (0.08)**
		Male (%)	35 (18.3%)	31 (16.2%)	48 (25.1%)	32 (16.8%)	45 (23.6%)	191	
	Age	Low (≤14) (%)	39 (15.4%)	38 (15.0%)	69 (27.3%)	36 (14.2%)	71 (28.1%)	253	**2.041 (0.73)**
		High (≥15) (%)	14 (14.7%)	11 (11.6%)	30 (31.6%)	17 (17.9%)	23 (24.2%)	95	
Bookshelf	**Gender**	Female (%)	15 (9.6%)	17 (10.8%)	65 (41.4%)	20 (12.7%)	40 (25.5%)	157	**14.694 (0.00) *****
		Male (%)	38 (19.9%)	28 (14.7%)	49 (25.7%)	32 (16.8%)	44 (23.0%)	191	
	Age	Low (≤14) (%)	41 (16.2%)	33 (13.0%)	90 (35.6%)	34 (13.4%)	55 (21.7%)	253	**6.441 (0.17)**
		High (≥15) (%)	12 (12.6%)	12 (12.6%)	24 (25.3%)	18 (18.9%)	29 (30.5%)	95	
Bed	**Gender**	Female (%)	13 (8.3%)	6 (3.8%)	98 (62.4%)	8 (5.1%)	32 (20.4%)	157	**42.326 (0.00) *****
		Male (%)	38 (19.9%)	26 (13.6%)	56 (29.3%)	18 (9.4%)	53 (27.7%)	191	
	Age	Low (≤14) (%)	38 (15.0%)	25 (9.9%)	117 (46.2%)	19 (7.5%)	54 (21.3%)	253	**4.004 (0.29)**
		High (≥15) (%)	13 (13.7%)	7 (7.4%)	37 (38.9%)	7 (7.4%)	31 (32.6%)	95	
Wardrobe	**Gender**	Female (%)	8 (5.1%)	16 (10.2%)	64 (40.8%)	17 (10.8%)	52 (33.1%)	157	**7.498 (0.11)**
		Male (%)	17 (8.9%)	29 (15.2%)	58 (30.4%)	29 (15.2%)	58 (30.4%)	191	
	Age	Low (≤14) (%)	21 (8.3%)	33 (13.0%)	89 (35.2%)	38 (15.0%)	72 (28.5%)	253	**6.807 (0.15)**
		High (≥15) (%)	4 (4.2%)	12 (12.6%)	33 (34.7%)	8 (8.4%)	38 (40.0%)	95	
Bedside cabinet	**Gender**	Female (%)	14 (8.9%)	19 (12.1%)	6 2(39.5%)	16 (10.2%)	46 (29.3%)	157	

		Male (%)	30 (15.7%)	33 (17.3%)	35 (18.3%)	32 (16.8%)	61 (31.9%)	191	**21.422 (0.00) *****
	Age	Low (≤14) (%)	29 (11.5%)	35 (13.8%)	76 (30.0%)	36 (14.2%)	77 (30.4%)	253	**3.502 (0.48)**
		High (≥15) (%)	15 (15.8%)	17 (17.9%)	21 (22.1%)	12 (12.6%)	30 (31.6%)	95	
** p<0.05 *** p<0.01									

Table 6: Gender and age differences in different categories of furniture color choices

Furniture Name		**Red**	**Green**	**Blue**	**Yellow**	**White**	**Total**	**χ^2 (p)**
Desk	Female (%)	27 (19.0%)	13 (9.2%)	19(13.4%)	57 (40.1%)	26 (18.3%)	142	**5.751 (0.22)**
	Male (%)	23 (13.6%)	16 (9.5%)	39 (23.1%)	65 (38.5%)	26 (15.4%)	169	
Chair	Female (%)	34 (24.8%)	4 (2.9%)	20 (14.6%)	50 (36.5%)	29 (21.2%)	137	**16.384 (0.00) *****
	Male (%)	21 (12.1%)	17 (9.8%)	39 (22.5%)	69 (39.9%)	27 (15.6%)	173	
Bookshelf	Female (%)	30 (21.0%)	6 (4.2%)	29 (20.3%)	52 (36.4%)	26 (18.2%)	143	**7.427 (0.12)**
	Male (%)	23 (13.1%)	17 (9.7%)	32 (18.3%)	75 (42.9%)	28 (16.0%)	175	
Bed	Female (%)	62 (41.9%)	15 (10.1%)	27 (18.2%)	21 (14.2%)	23 (15.5%)	148	**27.001 (0.00) *****
	Male (%)	30 (17.8%)	20 (11.8%)	64 (37.9%)	24 (14.2%)	31 (18.3%)	169	
Wardrobe	Female (%)	30 (20.8%)	18 (12.5%)	29 (20.1%)	28 (19.4%)	39 (27.1%)	144	**12.008 (0.02) ****
	Male (%)	19 (11.4%)	19 (11.4%)	39 (23.4%)	56 (33.5%)	34 (20.4%)	167	
Bedside cabinet	Female (%)	41 (29.5%)	13 (9.4%)	29 (20.9%)	28 (20.1%)	28 (20.1%)	139	**10.356 (0.04) ****
	Male (%)	27 (16.4%)	14 (8.5%)	35 (21.2%)	54 (32.7%)	35 (21.2%)	165	
** p<0.05 *** p<0.01								

Table 7: Gender differences in different categories of furniture hue-choices

In the analysis of the gender differences in the hue choice, in addition to the original four hues (R, G, B, and Y), white (A03) was also included, since white was one of the children's favorite furniture colors according to the data (see Table 5). There are significant differences in the hue choice between children's gender for the four types of furniture ($p<0.05$). Among these four types of furniture, males preferred yellow and blue hue, while females preferred red hue (Table 7).

Effect of color preference on children's furniture color choice

A round of data screening was conducted to determine whether the children used any of their three preferred colors as the color of any of the six categories of furniture. The results showed that 273 out of 348 participants of this adolescent group used one or more of their three favorites as the color of any of the six categories of furniture, accounting for 78.4% of the total.

The color choices for each type of furniture were compared to each participant's individual color preference. The degree to which the color choice matches the individual preference color was calculated as a percentage figure, which was referred to as the Color Consistency Rate (CCR). This rating was first proposed in the Yu's study.[26] In other words, the CCR was the proportion of the number of children who used their preferred color as the furniture color versus the total number of participants. If color preference has no effect on their furniture color selection, this would mean children randomly select the furniture color: since there were 21 different colors, the probability that the preferred color is the same as the furniture color choice is about: 4.76%. If CCR substantially higher than 4.76%, then it can be explained that preference has a significant impact on children's furniture color choice.

Space types	**Study**			**Bedroom**			χ^2 **(p)**
Furniture name	**Desk**	**Chair**	**Bookshelf**	**Bed**	**Wardrobe**	**Bedside cabinet**	
Total number	348	348	348	348	348	348	
Most preferred color number (CCR)	82 (23.6%)	113 (32.4%)	57 (16.4%)	34 (9.8%)	62 (17.8%)	64 (18.3%)	64.359 (0.00) ***
Second preferred color number (CCR)	37 (10.6%)	43 (12.4%)	39 (11.2%)	38 (10.9%)	33 (9.5%)	27 (7.8%)	4.716 (0.452)
Third preferred color number (CCR)	29 (8.3%)	26 (7.5%)	34 (9.8%)	27 (7.8%)	27 (7.8%)	24 (6.9%)	2.298 (0.807)
Category Mean CCR	14.2%	17.4%	12.5%	9.5%	11.7%	11%	
Space Mean CCR	14.7%			10.7%			
Mean CCR	12.7%						
** p<0.05 *** p<0.01							

Table 8: CCR of six categories of furniture and two different spaces

The CCR for each category of furniture in then children's three most preferred color levels was substantially higher than 4.76%. Preference certainly affected adolescent children's furniture color choice. Compared to the bedroom space (mean CCR=10.7%), adolescent children were more inclined to use their preferred colors for study space furniture (mean CCR=14.6%, see Table 8).

Compared with the other five categories of furniture, adolescent children were most inclined to use their preferred colors for the chair (CCR=17.4%), and they were least inclined to use their preferred colors for the bed (CCR=9.5%, Table 8).

In the most preferred color level, there was a significant difference between the CCR of different categories of furniture (χ^2=64.359, p=0.00 < 0.01). This shows that in different furniture categories, the degree of preference affected children's furniture color choice (Table 8).

The bubble charts (Figure 5) reveal that in most preferred level, the qualitative relationship between personal color preference (horizontal axis) of the three types of furniture products used in this study and color choice (vertical axis).

The size of each bubble represents the proportion of children who used their preferred color as the color of each type of furniture. When the proportion of children with a specific preference that selected a particular furniture color exceeds 30%, the percentage value was marked in black in the center of the bubble (see Figure 5).

The yellow bubbles signify that the children's most preferred color coincides with that of their furniture color choice. Conversely, the blue bubbles indicate that preference did not align with choice. For example, more than 40% of children who chose muted green (MG), light red (LR) and dark yellow (DY) as their favorite colors picked light red (LR) as the color of the bed (Figure 5). In other words, the larger the yellow bubbles, the more the adolescent children preferred to use their preference color as furniture color; larger the blue suggest that children were less inclined to use their preferred color for furniture.

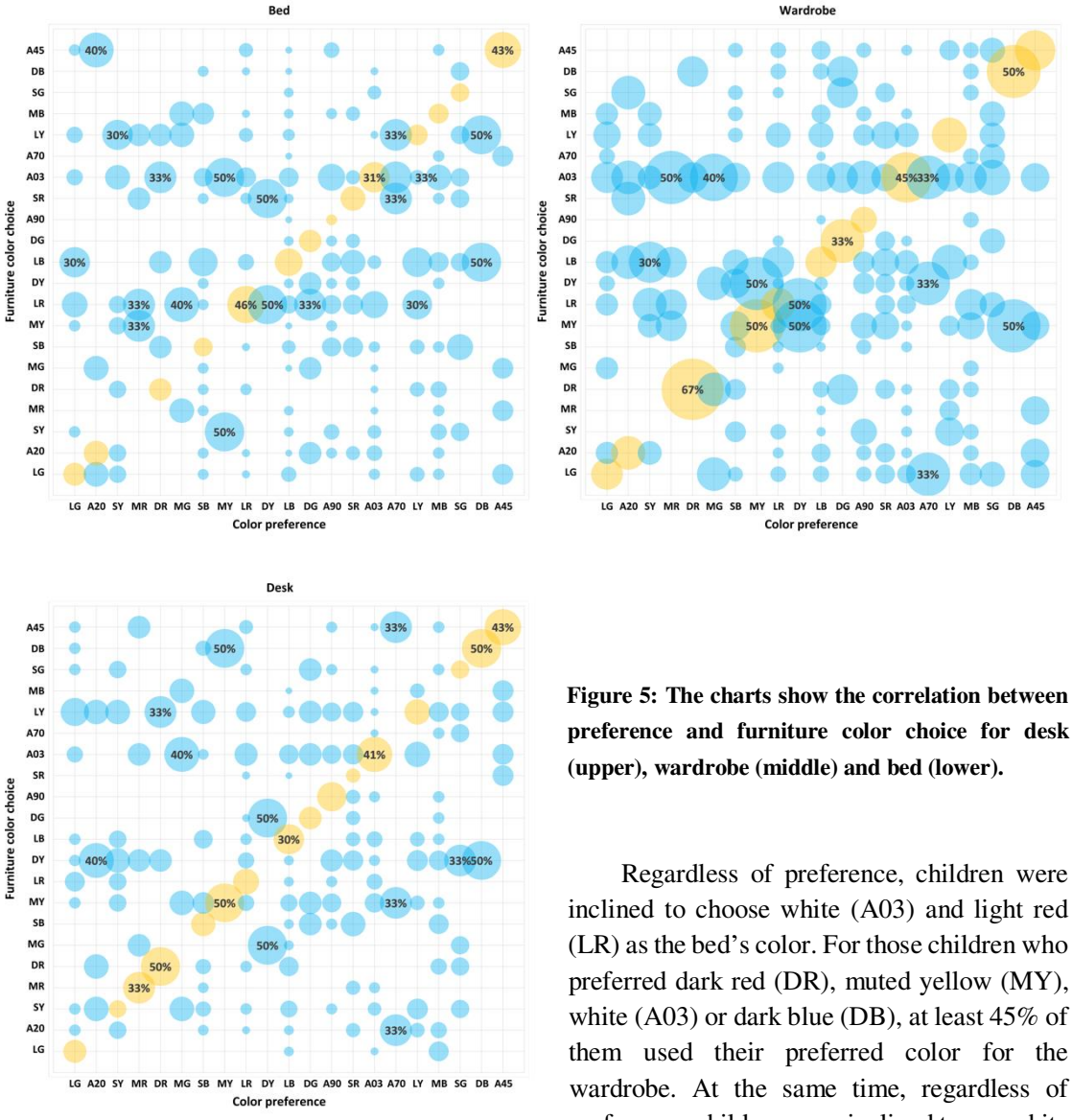

Figure 5: The charts show the correlation between preference and furniture color choice for desk (upper), wardrobe (middle) and bed (lower).

Regardless of preference, children were inclined to choose white (A03) and light red (LR) as the bed's color. For those children who preferred dark red (DR), muted yellow (MY), white (A03) or dark blue (DB), at least 45% of them used their preferred color for the wardrobe. At the same time, regardless of preference, children were inclined to use white (A03) as the wardrobe's color. In children who liked dark red (DR), muted yellow (MY), white (A03), dark blue (DB) or middle gray (A45), at least 43% of them used their preferred color as the desk's color.

DISCUSSION

The main focus of this study was whether the choices for furniture color by adolescent children are affected by their color preferences. The mean CCR of all categories of furniture in this work was 12.7% (significantly higher than 4.76%, see Table 8). However, this is not high compared to products in other fields. In a study of household products, the average CCR was over 30%.[26] In another study on personal-care products, the CCR of some categories of products (such as body wash) even exceeded 40%.[24] The results showed that color preferences certainly influenced children's furniture color choices. However, compared to other categories of products, the influence was limited.[24,26]

For different types of furniture, the influence level of color preference has a significant difference ($p<0.01$). Children were most inclined to choose their preferred color for the chair (Category mean CCR=17.4%), and the least inclined to choose their preferred color for the bed (Category mean CCR=9.5%) (Table 8). Interestingly, compared to the furniture in the bedroom (Space mean CCR=10.7%), adolescent children were more inclined to use their favorite color for furniture in the study (Space mean CCR=14.7%) (Table 8). This indicated that CCR between the color patch and furniture may be influenced by the functional spaces. Compared with related literature, there were other factors. Color preferences for room and furnishings may vary by, the color appropriateness of objects under cultural contexts[45] and decorative styles[46,47], emotions and feelings while inhabiting[48], affective qualities in real-life[49], and the association of color conventions with particular objects[14].

A limitation of this work is that, when asking participants to choose the color of the bed, the question did not indicate whether it was the color of the bed itself or the color of the linens (sheets, duvets, etc.). This may be confusing to participants. This result allows practitioners to focus on the differences in color design strategies for different types of children's furniture. Similar to previous literature,[24-26] the influence of color preference varied by the categories of product. For some products, such as automobiles, espresso makers, and mugs, individual color preference was a decisive factor in product choice.[25,26] For other products, such as face cream, shampoo and hand soap, the effect of color preference was negligible.[24] Therefore, it is necessary to enrich the categories of products in future studies.

With regard to adolescent children's color preference, the results showed that children preferred low blackness (group L) and high chromaticness colors (group S). Related studies only showed that children preferred saturation (high chromaticness) colors.[32] The results of this study showed differences for blackness: children were more fond of light (low blackness) colors than dark (high blackness) colors. Among the four hues, children preferred red and blue to green and yellow, and this trend became more obvious as the blackness decreased. This result is similar to the related works: some highlighted that, starting from infancy (4 to 24 months), both genders start to prefer red hue.[36,50-53] Moreover, this pan-gender red preference will continue into adulthood.[29,54-56] Also, this conclusion has revealed the adolescent children's preference for achromatic colors, especially white. In the past, research on children's color preferences sometimes neglected to use achromatic colors under different blackness levels. For example, in their color samples, one lacked gray and black to compare with white[57], another lacked white to compare with black and gray[41].

There have been seen significant gender differences in adolescent children's color preferences ($p<0.01$). Males preferred high chromaticness (S group), low chromaticness (M group), and achromatic (A group) colors. In the S, M, and L groups, males significantly preferred blue hue. Only in the L and M groups did females significantly preferred red. For the preference of red and blue hue, lots of studies found that blue was the most popular hue among all ages and genders.[30,32,58-60] Red was also a popular hue for both genders, female preference for red was higher than that of males.[29,54-56] The results of this study showed that the hue preferences according to gender were

slightly different under conditions of varying blackness and chromaticness. No significant difference due to age was found. Compared to previous works, children's color preferences varied by age.[32,33,35,40,41,61] At around 2 years of age, boys preferred blue (over pink) while girls preferred pink (over blue).[33,35] However, when entering school age, aside from blue, boys also preferred green, red, and black.[61] As age increased, the preference for high saturation decreased, and the consistency of hue selection increased.[40] The age range of this study is relatively narrow (12-16 years old), which may be the reason why no age difference has been found here.

An interesting result was that adolescent children exhibit consistency in their furniture color choice. Children preferred white (A03), light yellow (LY), light blue (LB), and light red (LR) for the furniture's color. This preference for light-colored furniture seems to have existed since infancy.[27] In study spaces, children preferred yellow hue; in a bedroom, children preferred blue and red hues. Compared with related literature, children and adults have obvious differences in their choice of furniture color.[13,15] Adults were more inclined to choose furniture with dark and muted colors rather than light and saturated colors.[15] For the sofa and chair, the favorite hue of adults was brown, three blackness levels of brown (light, normal, and dark) were popular for adults.[13] Moreover, for the couch, as was the same as adolescent children, red and blue were adult's favorite hues, but adults especially preferred dark red and dark blue.[15] Furthermore, adolescent children also showed a significant preference for white furniture. In all six categories, white was one of the top two popular colors (Table 5). In five out of six cases (the desk, chair, bookshelf, wardrobe, and bedside cabinet), white was the most popular color (Table 5). Compared to children, adults did not show a significant preference for white furniture in related studies.[13,15] Therefore, more exploration is needed on children's white furniture preferences.

For bookshelves, beds, and bedside cabinets, there were significant gender differences in the choice of color categories ($p<0.01$). Females preferred low blackness colors (group L) than males. Among them, in bookshelf and bed, males preferred high-chromaticness colors (group S). For the bedside cabinet, males preferred low-chromaticness colors (group M). There were significant gender differences in the hue-choice for four out of six cases (the chair, bed, wardrobe, and bedside cabinet, both $p<0.05$). Among them, males preferred yellow and blue, while females prefer red. Consistent with previous research, the gender difference was found in different types of product color choices, such as personal-care products[24], flowers[62], furnishings[13], automobiles[25], and clothes[13]. No significant age difference was found in their furniture color choice. This finding can help practitioners understand the difference in furniture color between different genders of adolescent children to adapt their design strategies for different genders.

The innovations in this study are as follows: firstly, it has expanded the range of product categories where there was little research on furniture color. This study also widened the age range of participants. Secondly, regarding color samples, compared with previous studies[24,26], this work adopted NCS notation and carried out a more systematic analysis of hue, blackness, and chromaticness. Thirdly, considering that achromatic colors are popular for furniture, this study adds five achromatic colors (black, white, and three intermediate grays). Fourthly, in the classification of adolescent children's furniture according to different space functions, this study categorized children's furniture in two types, which are study space and bedroom space furniture.

The limitations of this study are that, firstly, there was no in-depth analysis of the reasons for the differences in children's color preferences and furniture color choices. Second, according to related literature, aside from gender and age, ethnic and cultural backgrounds could also influence individual color preference[54,63-68], which needs more exploration in the future. A previous study showed that American children had a significant preference for red while Lebanese children preferred blue.[64] Another study showed that Arab women preferred red-purple, while British women preferred purple and blue-green.[54] Third, only single-color furniture was discussed in this work, therefore it is necessary to explore the color-combination furniture in future studies. For the same

product, there might be differences between single-color preference and color-combination preferences. A study showed that people focused more on hue and saturation rather than lightness when combining the colors of their shoes.[69] Fourth, only four primary hues of NCS notation were used in this study. However, more hue samples will need to be used in future studies, especially secondary hues, such as orange, purple, cyan (blue-green), etc.[15] Some studies revealed a strong blue-green hue preference for both genders.[32,58,59] Others studies showed that girls more often chose pink and purple hue as their favorite.[33-35] Fifth, this work is based on color patches and the imagined furniture's color rather than real furniture's colors. The validity of the results upon how well imagined furniture's colors represent the real furniture's colors.[14] Therefore, future studies with colors applied to real furniture are necessary. This study is the first part in a series of adolescent children's furniture color research.

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