

Darinka Fakin¹, Lavra Smoljanović, Alenka Ojstršek^{1,2}

¹ University of Maribor, Faculty of Mechanical Engineering, Institute for Engineering Materials and Design,
Smetanova 17, 2000 Maribor, Slovenia

² University of Maribor, Faculty of Electrical Engineering and Computer Science, Institute of Automation,
Koroška cesta 46, 2000 Maribor, Slovenia

Detection and Perception of Colour Regarding Gender and Age

Detekcija in zaznavanje barve glede na spol in starost

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Abstract

People have been accompanied by colours throughout the history and through all periods of life. In different eras, colours were also associated with status symbols of different social classes or mythological beliefs. We are often addressed emotionally by colour combinations, since colour perception is always and exclusively a sensorial experience. Various colour combinations can have a pleasant effect on us or leave us cold as well as in a state of shock. All of the above, presented the starting point of this research. Detection and perception of sensations through colour was accomplished by preparing a questionnaire related to 12 selected colours. The research included 302 participants from Slovenia, of both sexes and different ages, born from 1940 to 2004. From the obtained results, it could be concluded how popular a certain colour is in a material, design and spiritual sense. Moreover, the results were validated and compared regarding the gender and age of participants, and further compared with the results of previous studies.

Keywords: colour perception, survey, colour popularity, colour of joy, colour of clothes, colour of sleeping area

Izvleček

Barve spremljajo človeka skozi vso zgodovino in skozi vsa življenjska obdobja. V različnih obdobjih so bile tudi statusni simboli socialnih slojev ali mitoloških prepričanj. Barvne kombinacije, ki jih srečamo, nas čustveno nagovorijo, kajti dojemanje barve je vedno in izključno samo čutno doživetje. Različne barvne kombinacije lahko na nas delujejo prijetno, lahko pa nas pustijo hladne ali se nas celo neprijetno dotaknejo. Slednje je bilo izhodišče za našo raziskavo. Z izbranimi dvanajstimi barvnimi odtenki in pripravljenim anketnim vprašalnikom smo opravili raziskavo o zaznavanju in dojemanju barv. V raziskavi je zajet vzorec populacije 302 ljudi iz Slovenije, ki zajema tako ženske kot moške različnih generacij, leto rojstva od 1940 do 2004. Iz raziskave je mogoče ugotoviti priljubljenost posameznih barv tako v materialnem, oblikovalskem, kot tudi duhovnem smislu. Rezultati raziskave so ovrednoteni in primerjani glede na starostna obdobia in spol udeležencev, saj se ti med seboj razlikujejo, narejena je tudi primerjava s preteklimi raziskavami.

Ključne besede: zaznavanje barve, vprašalnik, popularnost barve, barva veselja, barva oblačil, barva spalnega prostora

1 Introduction

Colour is a subjective sensorial perception that depends on the physicochemical composition of the observed object, type of light, and physiological and

psychological abilities of the observer [1, 2]. The physical aspect of Colour Science, which is an interdisciplinary discipline, deals with light and its interaction. The chemical aspect covers the chemical properties of substances – colourants, which can under

Corresponding author/Korespondenčna avtorica:

Prof. Dr. Darinka Fakin

ORCID: 0000-0002-4251-8655

Telephone: +386 2 220 7637

E-mail: darinka.fakin@um.si

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the influence of visible light absorb or reflect light of different spectral wavelengths. The psychological aspect of colours considers the visual system of the observer, dealing with its influence on the well-being, consciousness and perception of colours.

The most important aspect of colour in daily life is probably the one that is least defined and most variable. It involves aesthetic and psychological responses to colour, and influences art, fashion, commerce, and even physical and emotional sensations [3]. However, detection and perception of colour is not isolated from other sensory elements, but is related closely to: (i) Perception of space and movement (dark colours seem closer, light makes things farther away), (ii) Weight perception (dark colours appear heavy, light lighter), (iii) Thermal sensations (red, orange, yellow and brown hues are "warm", while blue, green and grey are "cold"), (iv) Touch sensations (velvety are "soft" colours and metallic are "hard"), (v) Odour, (vi) Taste and (vii) Acoustic sensing [4]. Furthermore, red, orange and yellow hues are said to induce excitement, cheerfulness, stimulation and aggression; blues and greens security, calm and peace; and browns, greys and blacks sadness, depression and melancholy [3]. How we perceive colours depends also on our character, mood, past experiences (memory colour effect) [5], gender, age and cultural conditions – place and historical period to which we belong [6]. In addition, mental health is one of the very important factors influencing colour perception, i.e. schizophrenics have been reported to have abnormal colour perception. Also, specific colours can have a therapeutic effect on physical and mental disabilities [3].

Many authors have been dealing with colours in history, although, the studies are mainly related to the psychology of colours and their impact on the well-being, mood and health. A study similar to our research was published by A. Trstenjak in [10] and later by M. Tušak in [8], which summarised the research by M. Pfister [11], Gibson J. J. [12], H. Frielings [13] and others.

The aim of this study was to investigate the perception of sensations through colour, regarding gender and age, by preparing a survey together with 12 selected colours, representing the whole colour circle. The survey included questions about the (un)popularity of colours, the association of colours with joy, favourite colours of clothing and preferred colours of the sleeping area.

2 Experimental

2.1 Participants

In the presented study, 302 persons participated in total, 195 females and 107 males, from whom 5 persons (1 female and 4 males) had different colour perception disorders (self-proclaimed). In order to compare the obtained results, three groups were generated according to the year of birth, i.e. 1st group 1940–1970 (47 females and 19 males), 2nd group 1971–1990 (60 females and 46 males), and 3rd group 1991–2004 (88 females and 42 males). The percentages of participants included in the study regarding the year of birth and gender are disclosed in Figure 1.



Figure 1: Participants included in study

2.2 Test samples and survey

For the purpose of this research, a survey was prepared with nine questions. The first three questions were related to gender, year of birth and the colour vision disorder of participants included in the research, whereas the other six questions were connected to the perception of sensations through colour. Firstly, participants had to sort the 12 selected colours (cf. Table 1) regarding their popularity by creating a personal scale, from the most popular to the least popular colour. The next question was related to the perception of joy through colour, i.e. selection of the most and the least joyful colours. In addition, participants needed to select the colour of clothing they prefer to wear and finally, what colour they favour for their sleeping room. The collected answers were calculated as a percentage of the total number of participants in each group (gender and date of birth).

Together with the survey, 12 selected colour samples (i.e. black, grey, white, pink, purple, blue, turquoise, green, yellow, orange, red, brown) were prepared according to the RAL colour system, measured using a UV-VIS SF 600 Plus (Datacolor) spectrophotometer (cf. Table 1) and positioned in the CIE a^*b^* colour space (cf. Figure 2). The survey was conducted in July and August 2018 in a physical form, for all participants to be able to evaluate

Table 1: Selected colours according to RAL [7] and CIE $L^*a^*b^*$ measured values

Colour pattern	RAL mark	Naming colour	Measured CIE $L^*a^*b^*$ colour value				
			L^*	a^*	b^*	C^*	h
[Black]	15 00	black	27.42	0.21	-0.42	0.47	296.53
[Grey]	270 70 10	grey	71.56	-0.21	-9.41	9.42	268.74
[White]	290 90 05	white	90.31	0.94	-2.47	2.65	290.80
[Pink]	340 70 30	pink	70.36	27.58	-9.92	29.31	340.22
[Purple]	300 60 35	purple	60.77	16.84	-28.56	33.16	300.53
[Blue]	250 50 40	blue	52.70	-12.75	34.52	36.80	249.73
[Turquoise]	180 70 25	turquoise	70.66	-24.42	0.17	24.42	179.56
[Green]	120 70 50	green	70.92	-23.90	40.93	47.40	120.28
[Yellow]	090 90 60	yellow	89.19	0.18	57.06	57.06	89.82
[Orange]	050 60 70	orange	60.92	42.83	44.65	61.88	46.19
[Red]	030 40 60	red	44.35	44.60	21.28	49.41	25.51
[Brown]	060 40 40	brown	45.04	17.00	25.35	30.53	56.15

the same colour patterns, which could not be possible through a social network survey (different screens, screen settings, devices etc.).

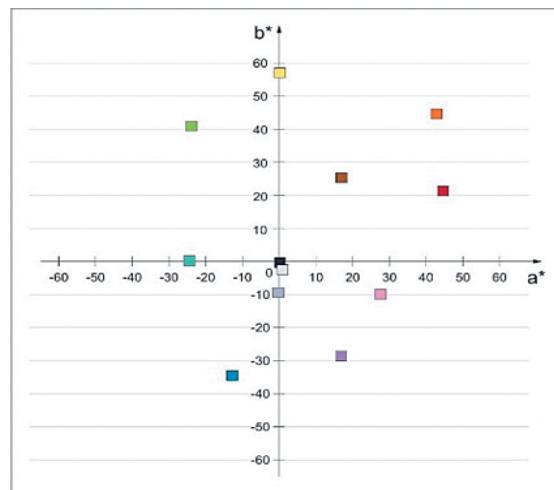


Figure 2: Position of colour samples in CIE a^*b^* diagram

3 Results and discussion

3.1 Popularity and unpopularity of colours in general

The first objective of the presented study was to determine the popularity scale of the 12 selected colours, regarding gender and year of birth (Figure 3 – females and Figure 4 – males). The diagrams

capture the data of the whole scale; thus, a full picture is given of the colour range. The favourite colours are shown as a positive proportion of colours (+) above indifferent colours (less than 5%), and unpopular colours are shown at the bottom of the scale as a negative share (-).

From Figure 3, it can be observed that the favourite colour for females born between 1940 and 1970 was blue (19.6%), followed by red, green and turquoise. The least popular was brown (30.4%), followed by grey, black and finally, pink. Other colours were of minor interest. The second female group (1971–1990) preferred red (14%), blue and green, and refused brown (40%), grey and pink. The youngest females preferred black (13.3%), blue and white, and refused brown (39.9%), orange and purple.

In general, the least popular colour in all three groups was brown and the central position on all scales was reserved for turquoise, with ca. 4–6% of popularity. Orange, which was popular in the eldest population (8%), proved to be a less popular colour for the youngest participating group, with almost the same share (-8.2%). In contrast, black was shifted from less popular (-10%) by the oldest generation to the most popular colour (13.3%) by younger females.

Figure 4 shows the popularity of colours in male groups, from which less difference could be perceived in comparison with female groups, i.e. the most popular colour was blue (up to 34.5%), the

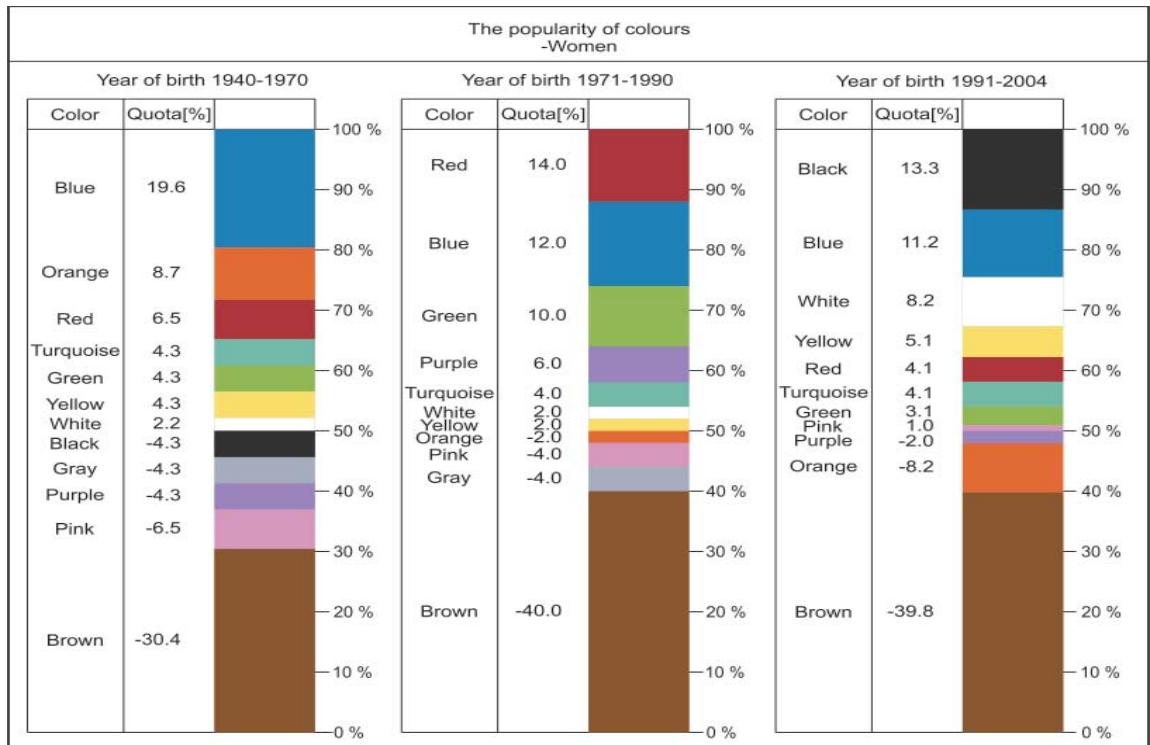


Figure 3: Colour popularity among female participants

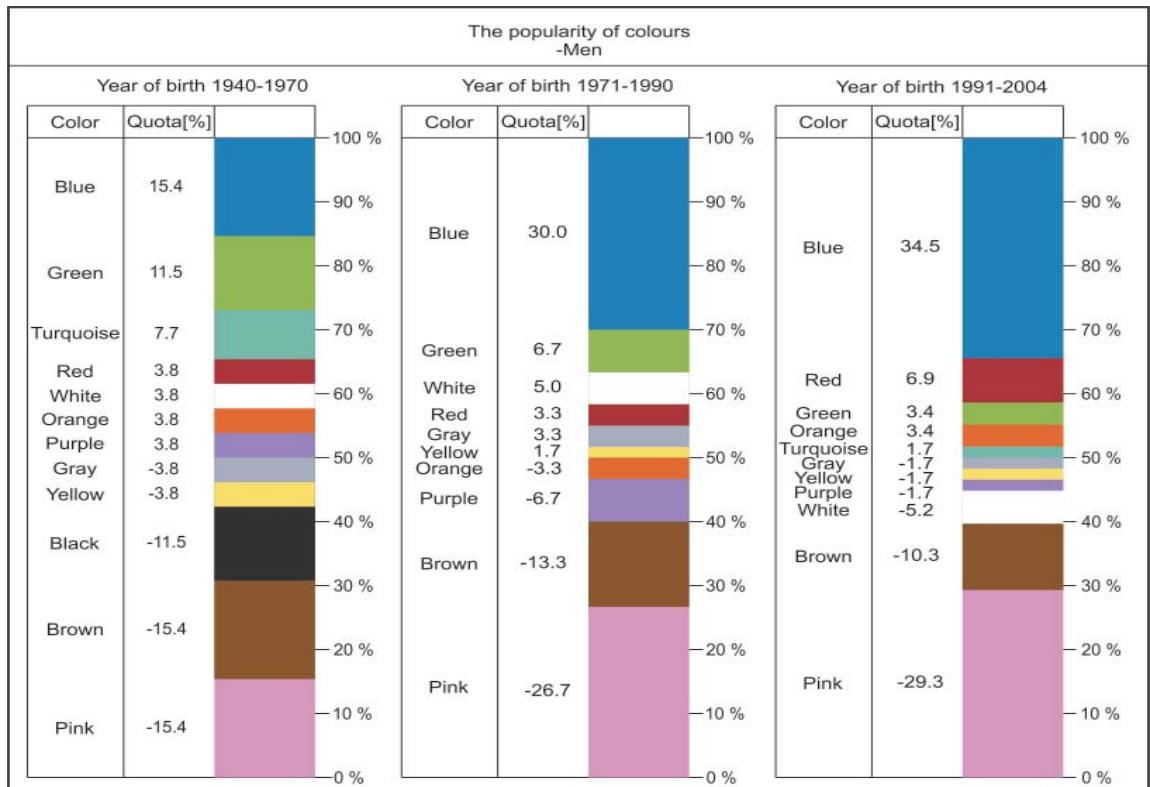


Figure 4: Colour popularity among male participants

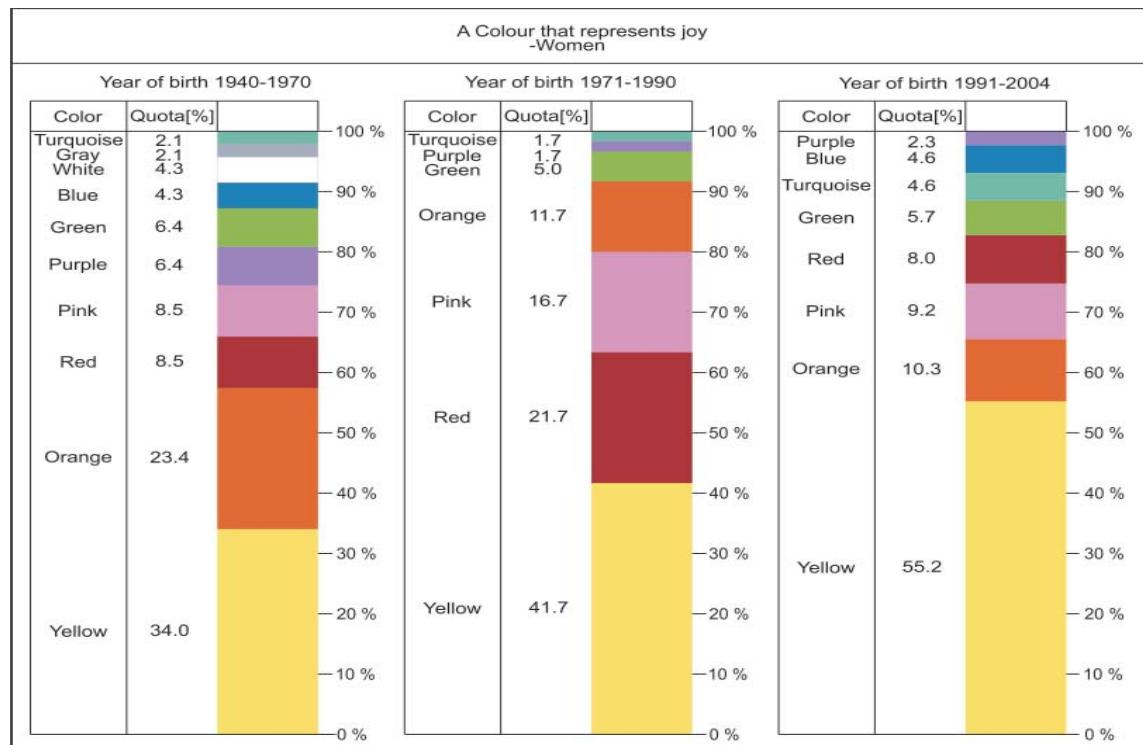


Figure 5: Colours of joy for females

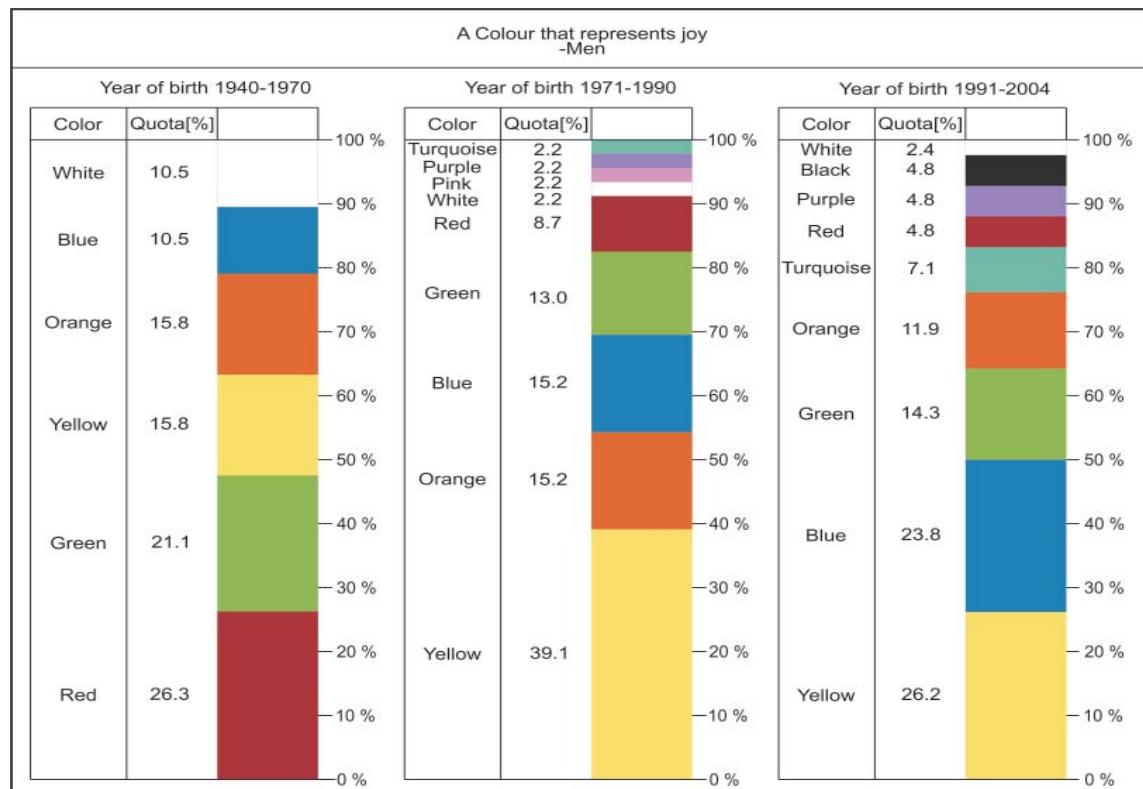


Figure 6: Colours of joy for males

least popular pink (up to 29.3%), and indifferent colours were orange, grey and yellow, with percentage differences between ages.

If we compare both genders and all ages (cf. Figures 3 and 4), a relatively popular colour was blue, more for males (up to 34.5%), unpopular was brown, more by females (up to 40%), and indifferent was yellow. In addition, women prefer red and men green colour, and both declined pink (men to a higher extent than women).

The findings of the presented research were compared with other studies as follows. In 1994, Tušak [8] interviewed gymnasium students and students of secondary vocational schools, and found out that blue was the most popular colour for both genders and for all researched groups. The second most popular colour among boys was green (gymnasium) and red (secondary vocational schools). The second most popular colour among girls was purple (gymnasium) and black (secondary vocational schools). The most unpopular colour at boys was pink, followed by yellow and brown. The most unpopular colour among girls was yellow (gymnasium), followed by pink and brown (secondary vocational schools). If we compare the results with our studied group (1991–2004), which was wider, but also included tertiary level students, some similarities as well as differences could be found, i.e. blue was the most and pink the least popular colour among males in both studies. The biggest differences were between the (un)popularities of colours among females.

In addition, Tušak [9] conducted a survey of colour popularity in a group of people aged between 60 and 87 years, without division by gender, which could be compared with our group of participants born between 1926 and 1970. Blue turned out to be the most popular colour in both researches, followed by green (as in our research for males) and red (second most popular colour for females in our study). The most unpopular colour in Tušak's research was black, followed by yellow and brown, while in our research, the least preferred colour for females was brown, followed by black, and for males pink, followed by brown.

A recent study prepared by Guzelj et al [14] in 2016 examined the emotional response to colours in a sample of the female population in Slovenia, revealing whether a selected colour was perceived as pleasant or not. Similarities with our study could be seen in the popularity of colours by age. Elderly females

preferred red and blue, and declined black as a popular colour. Interestingly, in a survey [14], most women selected purple as the colour they like. In our study, purple was less popular among females, except in the group born between 1971 and 1990.

3.2 Colour of joy

Figures 5 and 6 present the colour of joy for females and males, regarding their year of birth.

From Figure 5, it can be noted that yellow represents joy for females of all tested ages. In the first group (year of birth 1940–1970) and third group (1991–2004), yellow was selected by 34.0% and 55.2%, respectively, followed by orange and pink. The middle-aged group preferred yellow (41.7%), followed by red, pink and orange. All the mentioned colours are the so-called warm colours, except for pink. The minority of females of all ages (1.7 up to 2.3%) selected turquoise and purple as the colour of joy.

Figure 6 presents a rather different perception of joy through colour for men compared to women. In the younger generation (1991–2004), two so-called cold colours, blue and green (following yellow), represented the colour of joy, revealing blue as a very important colour in everyday life. Contrarily, the generation of men between 1940 and 1970 favoured red (26.3%) as the colour of joy, followed by green (21.1%), and yellow and orange in the same percentages (15.8%). On the opposite side of joyful colours for men, there were white, purple, turquoise and black.

The study performed by Kovachev and Musek [15] got similar results as presented in our study. Their survey included mainly female students, who most often associate joy with the red colour, followed by yellow and orange. In our study, women quite often selected pink (8.9% up to 16.7%), which was not available in a comparative study [15].

From the physiological point of view, yellow is the strongest colour, and relates to emotions, self-esteem and creativity [4]. Yellow is thought of as joyful, outgoing, open and friendly. In colour-mood association studies, yellow is associated with comedy, happy mood and playfulness. It occupies the largest range in the visible spectrum and has a beneficial effect on the eye and nervous system [16].

3.3 Favourite colour of clothing

Figures 7 and 8 present favourite colours of clothes for women and men, respectively, regarding their year of birth.

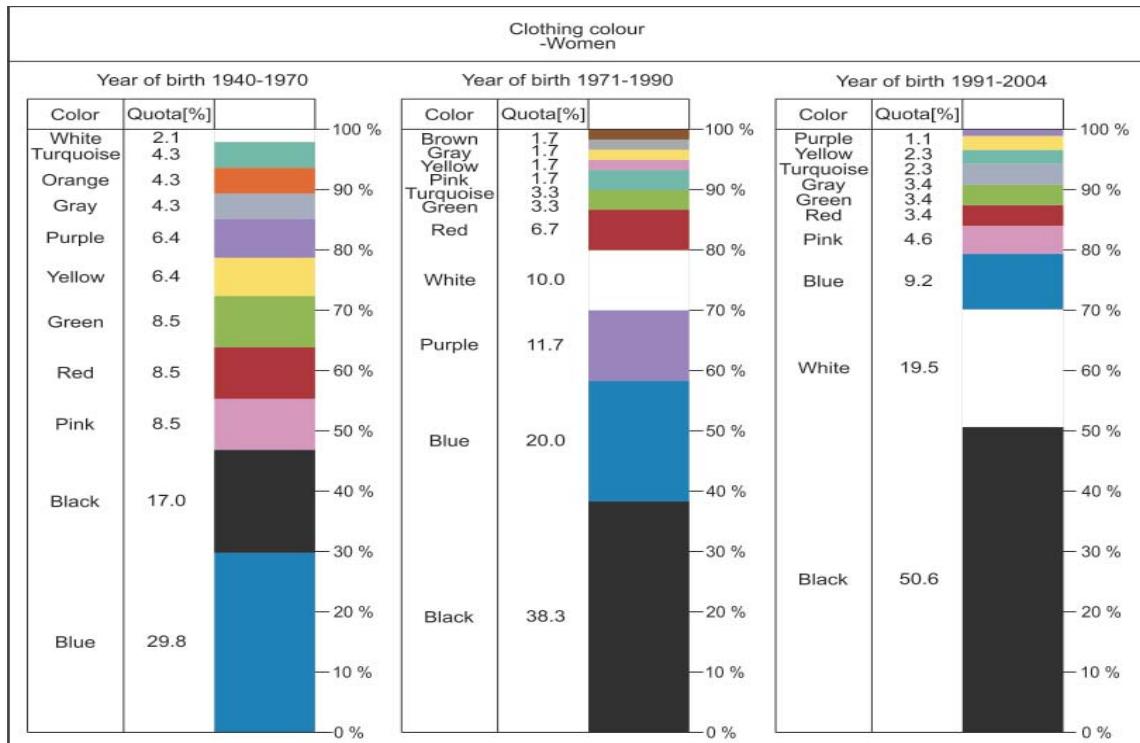


Figure 7: Favorite clothing colours among females

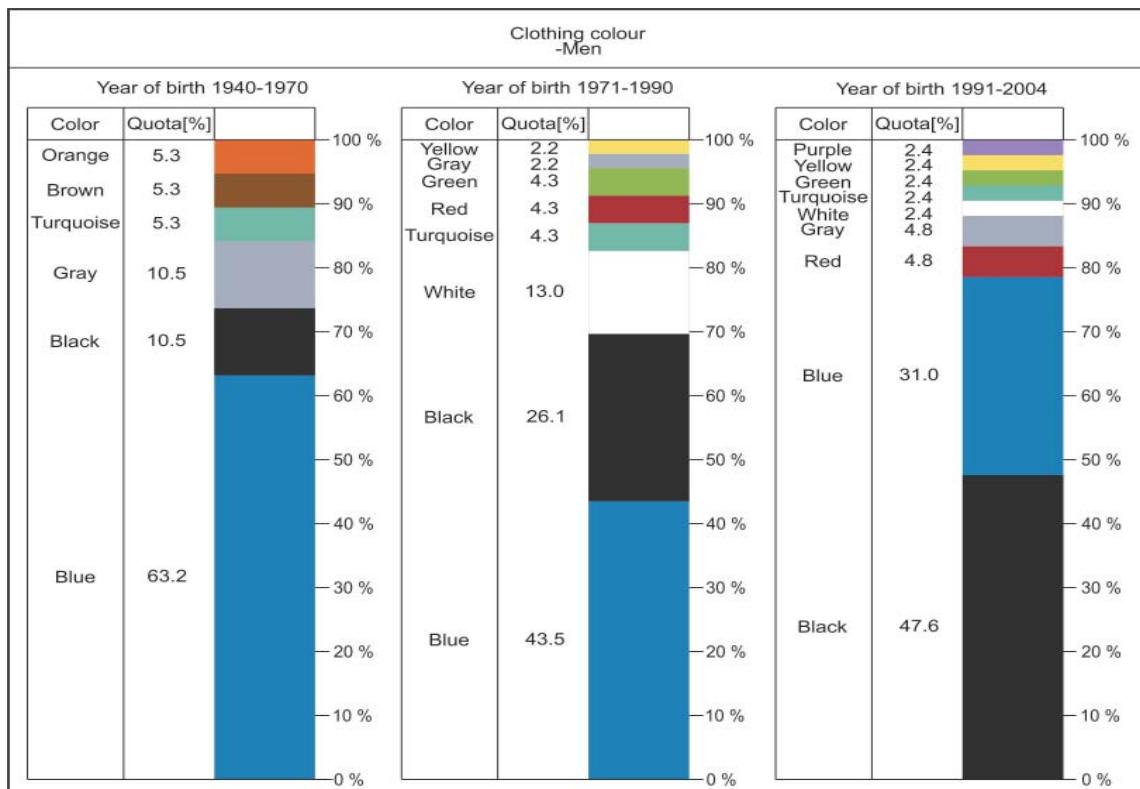


Figure 8: Favorite clothing colours among males

In Figure 7, minor differences can be observed among the favourite colours of female clothes regarding age. The oldest population (1940–1970) preferred blue (29.8%) over black (17.0%) and pink (8.5%), the population in their middle ages (1971–1990) black (38.3%) over blue (20.0%) and purple (11.7%), and the youngest ones (1991–2004) black (50.6%) over white (19.5%) and blue (9.2%). The minority of females preferred brown, purple, yellow and turquoise, with small differences between ages. It is not surprising that the black colour is the favourite colour for clothes, as it can be combined with all other colours, it is appropriate for all occasions, different subcultures, and can hide body's shortcomings. The answers about the favourite colours for clothes among males (cf. Figure 8) were similar to those by females, but in different percentages. The eldest population (1940–1970) preferred blue (63.2.4%) over black (10.5%) and grey (10.5%). Then, the popularity of the blue colour diminished by lowering the age, on account of the black colour, i.e. in the population in their middle ages (1971–1990), black (43.5%) still dominated over blue (26.1%), and in the youngest population (1991–2004), black (47.6%) dominated over blue (31.0%).

If we compare the popularity of colours of garments by gender, it can be concluded that the trend is blue and black. The choice of black decreases with age, while the popularity of blue increases. Most men preferred cooler colours, while women selected some warm colours as their favourite ones. In some cases, women chose the pink colour that was not found in the men's answers. This can be linked to the colour popularity chart (cf. Figure 4), as pink was one of the undesirable colours according to men.

Trstenjak [10] investigated in 1996 the popularity of dress colours of persons aged 15 to 22 years, which could be compared with our 3rd study group (1991–2004). He found out that grey was the most popular colour for males, followed by blue; in our study, black was ahead of blue. The female population in Trstenjak's research preferred blue in a high percentage over red in a low percentage. The data obtained from both surveys for young female populations are not comparable at all. Two decades have passed since Trstenjak's survey and the above comparison shows that the popularity of certain colours has, as expected, changed over time since the colour of clothes (especially for women) is in close relation with fashion.

3.4 Colour of sleeping area

Figures 9 and 10 represent favourite colours of the sleeping area separately for women and men, regarding their year of birth.

From Figure 9, it can be observed that the white colour is the first choice for the sleeping area for females of all tested ages. Here, the similarities between groups stopped. In the first group (1940–1970), females also preferred yellow, green and grey, in this order, in the second group (1971–1990) they chose green, yellow and pink, and in the third group (1991–2004), blue, turquoise and orange. Women like cold colours in their sleeping area, e.g. white, blue, green and turquoise, although some also preferred warm colours, e.g. yellow and orange. In the youngest generation, 3.4% of females picked black as their favourite colour for their sleeping place. This colour was not favourite for other generations, from which it could be concluded that the younger generation follows the trends and changes colours more easily in indoor surroundings.

Elderly men and those in their middle ages were more traditional and favoured the white colour for their sleeping space in relatively high percentages (cf. Figure 10), i.e. 52.6% (1940–1970) and 58.7% (1971–1990). This trend changed with the youngest investigated group, where only 26.2% preferred white. Other popular colours were red and blue (1926–1970), green and blue (1971–1990), and blue and yellow (1991–2004). Similarly as in the youngest female generation (cf. Figure 9), 4.8% of males (cf. Figure 10) picked black as their favourite colour for their sleeping place.

We can conclude that white was the most popular colour for the sleeping surroundings irrespective of gender and age, whereas the popularity of other colours changed by age. Black became the perfect choice for the youngest males and females, although for the 2nd and 3rd groups, black was not even on the scale.

Van der Voordt et al [17] studied in 2017 the popularity of colours in different rooms. His research found that the most popular colour for the bedroom was white, as in our study, followed by red, blue and green, which is similar to our study, with the exception of red, which was not among the favourite colours with our participants. The reason for choosing white for the sleeping space could be that people want to have as much light in the room as possible. White is the colour that reflects the lightest and

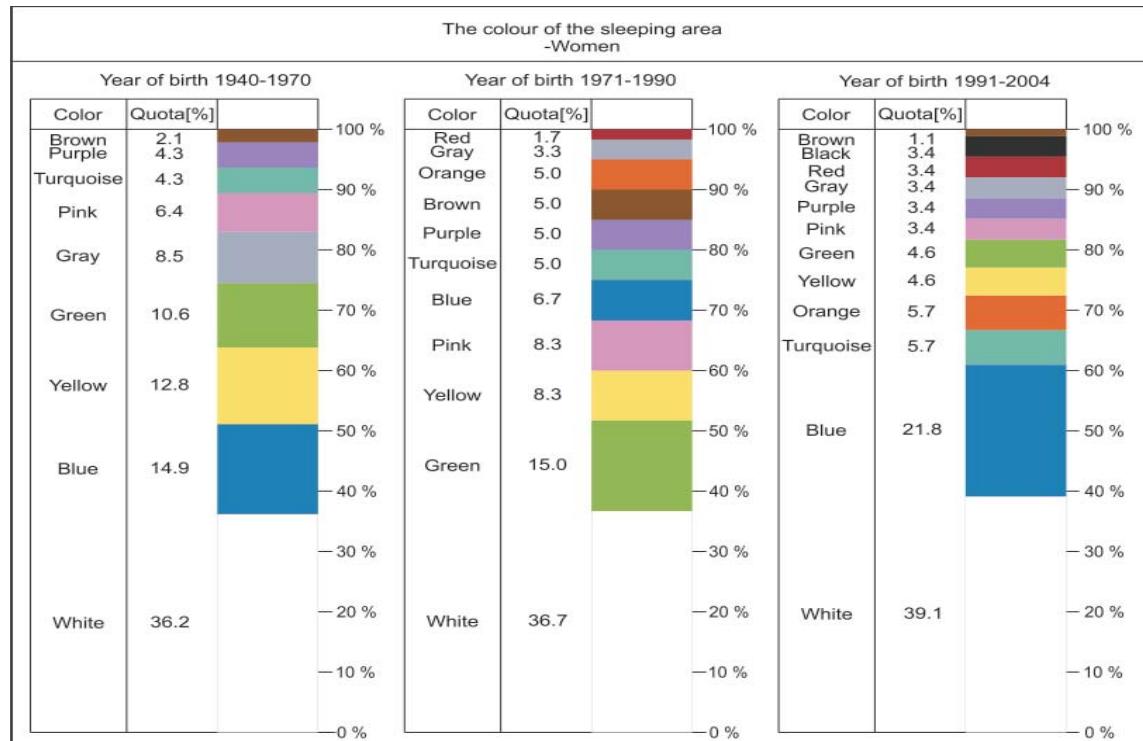


Figure 9: Females' favourite colours of sleeping area

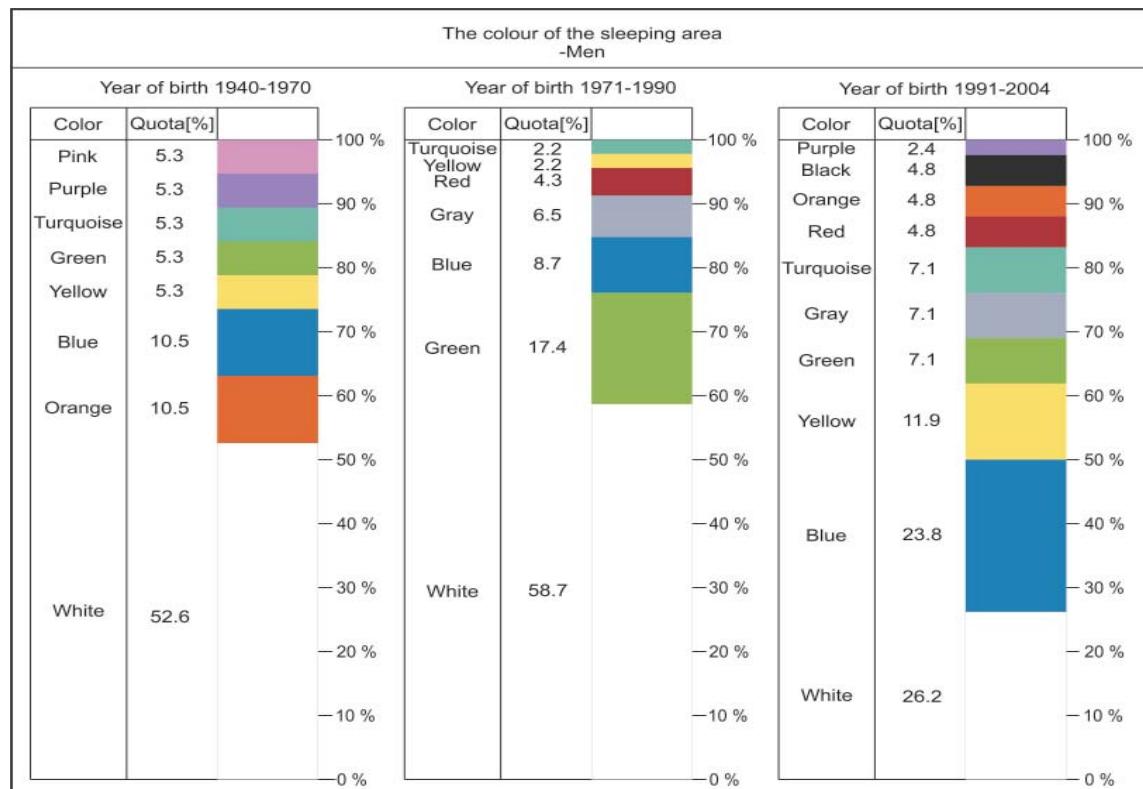


Figure 10: Males' favourite colours of sleeping area

therefore works as the brightest of all colours. The reason for its frequent choice could also be that white is considered as a safe choice and could be combined with all other shades in smaller proportions.

4 Conclusion

The purpose of the presented research was to investigate the perception of sensations through colour, regarding gender and year of birth, by preparing a survey together with 12 selected colours, representing the whole colour circle. The survey covered questions about the (un)popularity of colours, association of colours with joy, favourite colours of clothing and preferred colours of the sleeping space. We could find a symbolism in colours and establish that they can influence humans' well-being. Sometimes, we are unaware of their presence. The study gained a lot of data, providing a comprehensive view about the perception of colours. The presented research gave some general criteria of what we can expect from colours, while their perception still remains an individual choice. Colour perception is different by gender and age, although it is slowly changing with time, which could be a consequence of more aggressive propaganda of fashion/designers' industries through new (social) media and technologies. It would be interesting to perform a more detailed research within the individual sets of data obtained.

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