Exploring colour choice rank order and its relationship with heart rate variability

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This study collected data on colour choice rank using a 16-colour (Cernova) online test. The same participants undertook two well-known resilience questionnaires, and their heart-rate variability (HRV) was measured. Some studies have suggested a relationship between HRV and resilience. Key findings include: (1) Participants consistently showed distinct patterns in their first and last colour choices, with a strong preference for blue hues and lighter colours such as 'light cyan' and 'light blue'. Brown was rarely chosen as the most appealing colour but was frequently ranked as the least appealing. Gender differences were noted, particularly with females showing a stronger preference for pink and purple than males. However, after adjusting for the unequal gender distribution and considering the complete ranking order, no significant gender differences were found. (2) In terms of colour choice and resilience, individuals with low resilience scores tended to select 'black' and 'dark blue' as their early choices, whereas the optimal resilience group with moderate scores chose 'black' later in the ranking. Those who with higher resilience scores tended to select 'yellow' early on. (3) Although the optimal resilience group showed higher HRV, no statistically significant differences were found in the HRV measures across the three resilience groups. Overall, these findings suggest that while colour choices may reflect resilience tendencies, the relationship between colour choices and HRV was not strong enough to reach statistical significance.

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Introduction

Colour preference has been widely studied for at least a century [1]. The field was stimulated by a seminal paper by Cohn in 1894 that was described by Eysenck as the first to take an empirical approach to the subject [2]. However, whereas Cohn was unconvinced that some colours were more preferred than others, Eysenck attributed this conclusion to problems with the methodology that Cohn and others employed. In 1959 Guildford and Smith produced compelling evidence that some colours are systematically more preferred than others [3]. In these and related studies the term colour preference is used in an abstract sense; that is, a preference for red would infer that someone prefers red in a general context-free sense rather than, for example, that someone prefers red shoes or red cars over those objects in other colours. Colour preference in the context of certain objects has also been studied [4-5] and although it is clear that context can affect colour preference, the relationship between object colour preference and context-free colour preference is still an open question [6]. Studies of colour preference have consistently found that on average participants prefer blue colours and dislike yellow colours. Often this effect is phrased such that cool colours (blue, cyan and green) are generally preferred to warm colours (red, orange and yellow).

A recent review of the literature also confirmed that people tend to prefer lighter and more chromatic colours, that some gender differences exist, and that although there is broad agreement in colour preferences across cultures (people tend to like blue and dislike yellow) this is not sufficient to robustly conclude that colour preferences are universal across cultures [7]. For example, in one study it was found that blue was a least-preferred hue in Kuwait [8].

Despite the general trend that on average people tend to prefer lighter, more chromatic and cooler colours it is arguably more interesting that individuals vary in their colour preferences. Several ideas have been put forward to underpin the fact that people have colour preferences and that individual differences in these preferences exist. For example, Hurlbert and Ling proposed a physiological explanation based on an analysis of cone responses that explained differences between male and female colour preferences [9]. On the other hand, Palmer and Schloss have argued for a more cognitive explanation [6]. According to this explanation people like colours because of their emotional associations for those colours; in short, people like colours that remind them of things that they like. This Ecological Valence Theory of colour preference suggests that organisms may benefit by approaching objects whose colours they like and by avoiding objects whose colours they dislike. As has been noted by Palmer and Schloss, 'clear sky and clean water are universally blue, whereas biological wastes and rotting food are universally dark yellow' or brown [10]. Such observations might explain why there are systematic differences in colour preferences generally. Perhaps, an individual's life experiences may contribute to their specific colour preferences? Does this suggest a tentative link between colour preference and personality traits?

There is also quite a long history that suggests that the colour preferences of an individual might be related to aspects of their personality. Birren, for example, suggested in 1969 that different types of people have different colour preferences (e.g. that egotists favour yellow) [11]. Another study found that introverts preferred less chromatic, cooler colours to extraverts who preferred stronger and warmer colours [12] whereas more recently it was found that people scoring above average on an anxiety scale preferred less chromatic colours than those scoring below average [13]. It has also been found that extraverts preferred yellow and green more than introverts [14]. A very recent study with 206 participants found that those participants that selected blue as their most preferred colour scored highly in terms of agreeableness and extraversion and those that selected red scored lowly in terms of agreeableness [15]. Despite these previous studies, a meta-analysis in 2021 concluded that there was no evidence to support claims that colour preferences can reveal people's personalities [16]. Whether there is a relationship between colour preference and personality may still be an open question, however. There may still be methodological issues in trying to measure colour preference (for example, arguments about whether it is better to show participants a colour or, for example, to provide them a colour word as a prompt). There are also difficulties in trying to 'measure' personality especially using self-reported methods and some methods that may have been used many decades ago may have become discredited (e.g. the argument about IQ [17]).

The idea that colour preferences can reveal people's personalities has been popularised by The Lüscher Test. The test contains eight colours (blue, green, red, yellow, violet, brown, black and grey) and participants are asked to select their preferred colour; this colour then disappears (or is removed) and they are then asked to select their preferred colour from the seven remaining colours. The process continues until all eight colours have been ranked in terms of preference. Note, however, that the 8-colour Lüscher test with which most people are familiar is part of a larger test that contains 73 colours [18]. Nevertheless, many studies fail to find support for the validity of the 8-colour test. In one case, participants' first-ranked colour from the test was compared with their general favourite colour with little agreement since many participants chose favourite colours that were not in the test [19]. This

suggests that the 8-colour test contains too few colours to be reliable. In another study, little agreement was found between psychological reports generated for each of 42 students using two methods (the Lüscher test and the Minnesota Multiphasic Personality Inventory) [20]. A study in 1994 used self-assessment of personality and found no support for Lüscher's prediction that more extroverted people would prefer red and yellow colours [21].

One aspect of human psychology that may be related to colour preference is resilience which is the ability to return to (or maintain) a stable physical and psychological equilibrium despite experiencing stressful events [22]. The concept of resilience emerged from work on the psychological aspects of coping and the physiological aspects of stress [23]. Some authors distinguish between state-resilience (which may be distinguished by the dominant state at the time) and trait-resilience (which in adults may have developed since childhood) [24]. A review of instruments for measuring resilience [23] identified a number of methods including the Adolescent Resilience Scale (ARS) [25], the Baruth Protective Factors Inventory (BPFI) [26], the Resilience Scale for Adults (RSA) [27] and the Connor-Davidson Resilience Scale (CD-DISC) [28]. In addition to the self-reported questionnaires, an alternative approach to measure resilience has emerged in terms of heart-rate variability (HRV). Low HRV has been associated with anxiety disorders and depression [22].

The present study explores the potential of a relationship between a proprietary colour choice test and heart rate variability (HRV), both of which may be related to resilience. Resilience may be an indicator of student success in education contexts or the likelihood of accidents in manual-labour employment. This work could be useful for assessing individual resilience and identifying risks that may negatively impact performance and well-being in the workplaces or educational environments.

Experimental

Participants, data exclusion criteria and ethics

The research was conducted through two phases at the University of Leeds, UK. Initially, a cohort of over 200 participants comprising both students and staff was recruited on campus. However, a few participants withdrew from the study for various reasons, resulting in a final sample size of 196 participants who completed the research. In the first phase (Study 1: S1), 99 participants successfully completed the study. Subsequently, about three months later, during the second phase (Study 2: S2), 97 participants took part in a repeat of Study 1. Of these 97 participants, 67 participated in both studies.

In this present work, certain participants' data were excluded from the analysis due to previous experience with heart-related surgery, the presence of an electronic device embedded in their body (e.g., a heart pacemaker), current use of antidepressants or incomplete data for various reasons.

Therefore, the final analysis included 110 participants (72 female and 38 male) who participated in one or other of S1 and S2. The study received approval from the University of Leeds Ethics Committee (ethics reference: LTDESN-177).

Heart rate variability measures

The participants wore commercially available watches capable of measuring heart-rate variability (HRV). HRV is a complex phenomenon represented by various attributes calculable from the data. In this study, our focus lies on several key parameters: meanRR, SDRR, RMSSD, TP, $TP_{7\text{-}11}$, VLF, LF, and HF. Table 1 provides an explanation of each measure. The first three – meanRR, SDRR and RMSSD –

pertain to the time domain and are measured in milliseconds. The remaining five measures – TP, $TP_{7\text{-}11}$, VLF, LF, and HF – relate to the frequency domain and are measured in square meters.

This manuscript particularly focuses on (1) Standard Deviation of RR intervals (SDRR), representing overall HRV and (2) Total Power ($TP_{7\text{-}11}$), a measure of HRV from 7 am to 11 pm..

Measurement	Unit	Description	
meanRR	ms	Mean value of beat to beat interval (60/meanRR = heart rate). Heart rate is an intuitional indicator of stress.	
SDRR	ms	Standard deviation of RR intervals. Overall heart rate varability.	Time domain
RMSSD	ms	Root mean square of successive RR interval differences. Activity of parasympathetic nervous system.	
TP	ms^2	The overall sum of power across all frequency bands (0.0033 - 0.4 Hz).	
$TP_{7\text{-}11}$	ms^2	The overall sum of power across all frequency bands (0.0033 - 0.4 Hz) from 7am-11pm.	
VLF	ms^2	Power in the very low-frequency range (0.0033 - 0.04 Hz). Strongly associated with all-cause mortality than LF or HF power.	Frequency domain
LF	ms^2	Power in the low-frequency range (0.04 - 0.15 Hz). Activity of both parasympathetic and sympathetic nervous system.	
HF	ms^2	Power in the high-frequency range (0.15 - 0.4 Hz). Activity of parasympathetic nervous system.	

Table 1: Various HRV measures that can than can be extracted from the watch.

Resilience assessment

The participants completed the CD RISC-25 [28], which consists of 25 items, each rated on a 5-point scale from 'not true at all' to 'true nearly all of the time'. Additionally, they also completed the RSA [27], a 33-item test utilising a 7-point scale from extremely negative to extremely positive, or vice versa. In both self-assessments, higher values indicate greater resilience, with increased scores reflecting enhanced ability to cope with stress.

Colour choice test

The present study used a proprietary colour choice test [29] that employed the forced ranking method. The participants were instructed to choose colours from a set of 16 different options in the order of which one appeals to them most until all the colours were chosen. Note that participants were specifically asked to rank the colours that appeal to them most (in this sense, the test is strictly not a colour preference test but may be related to colour preference). Figure 1 shows the colours presented during the colour choice task.

Figure 1: The colours used in the colour choice task.

Drawing from a previous unpublished study by Cernova, it was revealed that the rank positions of five colours from this colour test may be indicative of resilience. These five colours, with their positions in Figure 1 in parentheses, include red (third from the right), yellow (eighth from the right), violet (fifth from the right), dark blue (sixth from the left) and black (second from the left). This allowed the development of an algorithm that – based on the positions of these five colours – generates a colour test score ranging from 0 to 100. A score of 50 indicates an optimal level of resilience, while scores above and below 50 signify above and below optimal level of resilience, respectively.

Study procedure

The participants were asked to visit the psychophysical lab twice on separate days. On day 1, each participant received a wearable heart monitor watch to use for about seven days (at least 48 hours) and completed the 'Resilience Scale for Adults' (RSA) questionnaire [27]. On day 2 (approximately seven days later), they completed the 'Connor-Davidson Resilience Scale' (CD RISC-25) questionnaires [28] and participated in the colour test.

As formerly mentioned, the research was conducted in two phases: Study 1 (S1) and Study 2 (S2). In S1, 99 participants completed the study, while in S2, 97 participants participated, with 67 partaking in both phases – each individual was reinvited to the study about three months later. The procedures were identical in both studies. An analysis of some of these repeated-measures data, specifically focusing on the comparison between S1 and S2, has been previously published [30].

Note that this present study solely focuses on examining the relationship between the results of the Cernova resilience colour choice test and the physiological measures (HRV scores). The results of the resilience questionnaires are not discussed in this paper.

Results

The analysis employed a range of analytical techniques and strategies, including pattern analysis, visual investigation, and comparative statistical analyses. Visual examination and rank calculation were carried out using MATLAB and Excel to explore colour rank patterns. Descriptive statistics and tests of differences pertaining to heart rate variability (HRV) measures were performed using Statistical Product and Service Solutions (SPSS) software.

Colour analysis: (1) Visual representation of individuals' ranking for 16 colours

We initially constructed a matrix with dimensions of 110 rows by 16 columns, where 110 represents the number of participants and 16 represents the distinctive colour numbers ranging from 0 (white) to 15 (light cyan). To facilitate a clear visualisation of this extensive dataset, Figure 2 presents the rank order data for each individual's choice of the 16 colours in three separate table boxes.

Within these tables, for example, the first column (on the left) indicates the participants' first choice of colour (most appealing colours – position 1), while the last column signifies their last choice of colour (least appealing colours – position 16). Notably, it seems that 'light blue' and 'light cyan' are positioned towards the left side of the table e. Conversely, 'brown' appears more frequently towards the right side. However, it is important to note that this observation is based solely on visual investigation and requires further analysis to draw more reliable insights.

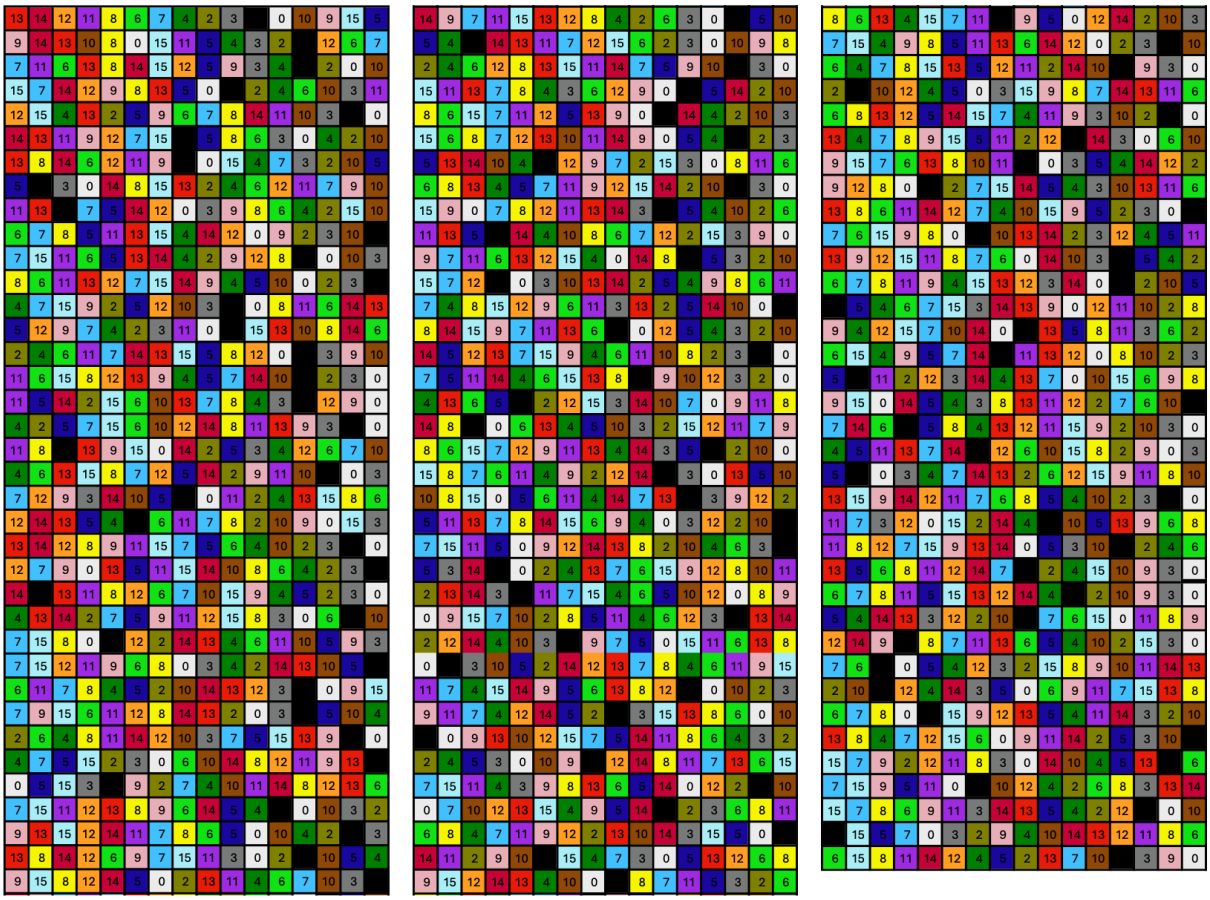

Figure 2: Visual representation of individuals' colour choices (n = *110).*

Colour analysis: (2) First and last choice of colours

Next, our attention shifted to understanding the significance of participants' first and last colour choices. Figures 3 and 4 present the percentage breakdowns for both the first (position 1) and last (position 16) colour choices, respectively, segmented by gender clusters. Note that gender influence in colour choices was also a focal point of our analysis, especially given the unequal distribution of participants, with 72 females and 38 males.

As depicted in Figure 3, 'light blue' emerged as the predominant first colour choice at position 1 for both genders, with 12.5% of females and 18.4% of males selecting it as their first choice, compared to its overall representation of 14.5%. Additionally, 'dark green', 'green', 'purple', and 'red' were also commonly selected as first choices by participants of both genders, aligning closely with their overall percentages. On the other hand, 'grey' and 'brown' were never or rarely chosen respectively as first choices by either gender, suggesting a lack of appeal. This observation may hint at a potential universal appeal (or lack of appeal) of these particular colours.

However, notable differences in colour choices between genders become apparent for certain colours. For example, 'green', 'pink' and 'purple' were often selected as first choice by females (8.3%, 9.7%, and 9.7%, respectively) among females but were less often selected as first choice by males (2.6%, 7.9%, and 2.6%, respectively) among males. On the other hand, 'dark blue' was first choice for 15.8% of males but only by 4.2% of females (males were more likely to select dark blue as first choice than females with a factor of almost four).

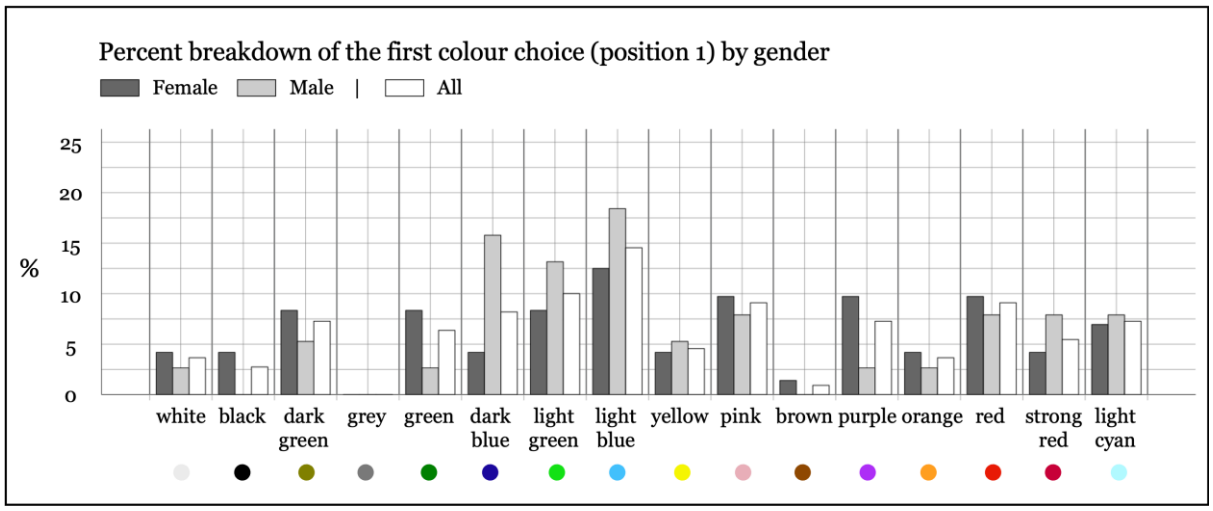

Figure 3: Per cent of first colour choices (position 1) by gender and total.

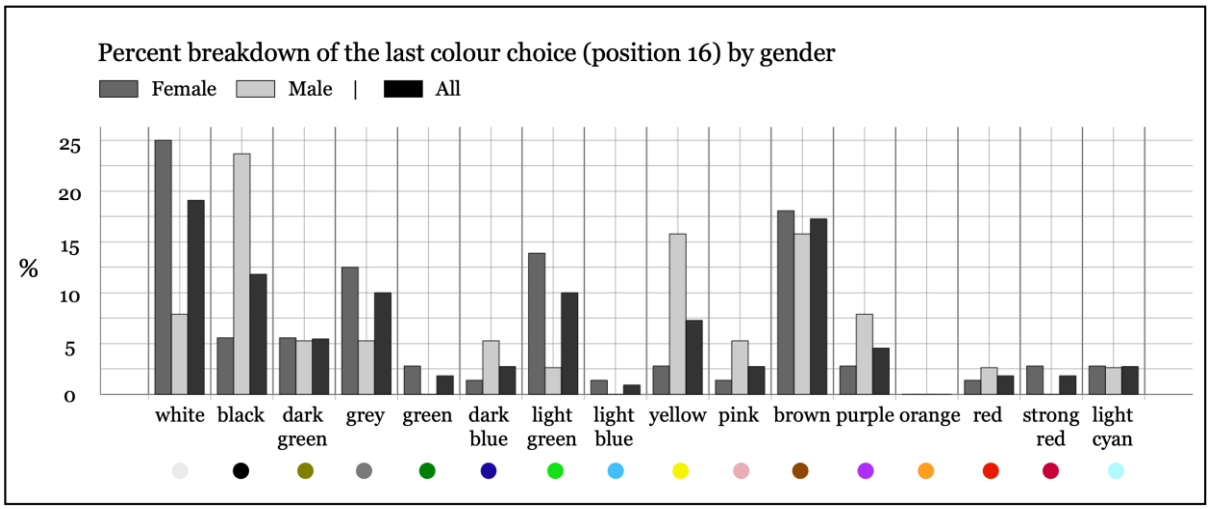

Figure 4: Per cent of last colour choices (position 16) by gender and total.

In Figure 4, regarding the last choice (position 16), 'brown' was frequently chosen by both genders. Interestingly, 'orange' was not selected by either gender at position 16. However, the last colour choices, compared to the first colour choices, varied more significantly between genders. Notably, 'white' was selected last by 25.0% of females but only 7.9% of males. Similarly, 'black' was chosen last by 5.6% of females and 23.7% of males. 'Grey' also saw notable differences, with 12.5% of females and 5.3% of males selecting it as their last choice.

It is evident that there are some gender-specific variations in these colour choices. However, it is important to highlight that this analysis method examines the first and last choice of colour only, rather than a consideration of the complete ranking order. Therefore, a conclusive interpretation cannot yet be made.

Colour analysis: (3) Colour choice pattern

Next, we conducted a forced-ranking analysis to explore participants' colour choices in more detail. The raw data matrix from the earlier visual investigation was first rearranged using MATLAB. This restructuring resulted in a revised matrix where each colour was assigned a position rank across all participants. Unlike the original matrix, which merely indicated the colours selected, this revised matrix

reflects the position rank of each colour among the 16 options, with rank 1 representing the colour that was chosen first and rank 16 representing the colour that was chosen last.

After restructuring the data, the means of these position ranks for all 16 colours were calculated using SPSS software, considering both the total sample (all: n = 110) and the distribution across gender categories (female: n = 72; male: n = 38). Table 2 presents the results of this analysis, with the colour ranks listed in ascending order based on the overall mean values.

	Female (n = 72)			Male (n = 38)			All (n = 110)		
	M	SD	ranking	M	SD	ranking	M	SD	ranking
white	10.74	4.63	14	10.13	4.34	12	10.53	4.52	14
black	9.94	4.68	12	10.32	4.79	13	10.07	4.70	12
dark green	10.24	4.53	13	10.37	3.98	14	10.28	4.33	13
grey	11.90	3.60	16	10.45	4.09	15	11.40	3.82	15
green	7.74	4.37	9	7.89	3.74	8	7.79	4.15	7
dark blue	7.69	3.97	8	8.42	4.89	9	7.95	4.30	9
light green	6.68	5.16	11	7.58	4.97	5	8.30	5.10	11
light blue	6.11	3.97	1	5.00	3.72	1	5.73	3.90	1
yellow	7.29	4.26	4	8.76	5.49	10	7.80	4.75	8
pink	7.79	4.65	10	8.79	4.75	11	8.14	4.69	10
brown	11.65	3.93	15	11.42	3.90	16	11.57	3.91	16
purple	7.64	4.36	7	7.58	4.69	5	7.62	4.46	6
orange	7.39	3.77	5	7.61	3.82	7	7.46	3.77	4
red	7.26	4.48	3	7.24	3.96	3	7.25	4.29	3
strong red	7.61	3.81	6	7.32	3.97	4	7.51	3.85	5
light cyan	6.32	4.17	2	7.13	4.38	2	6.60	4.24	2

Table 2: Mean rank position of each colour by gender and for all participants.

In Table 2, 'light blue' emerged with the lowest mean value of 5.73, indicating it is most likely to be chosen first, on average, followed by 'light cyan' with a mean of 6.60 and 'red' with a mean of 7.25. Conversely, 'brown' has the highest mean value of 11.57, suggesting it is more frequently chosen last (or towards the end of the ranking). Colours like 'light blue', 'red', 'strong red', 'purple', 'light green', 'white', 'grey', and 'brown' appear to be appealing to males compared to females. But colours such as 'light cyan', 'orange', 'green', 'yellow', 'dark blue', 'pink', 'black', and 'dark green' appear to appeal more to females than to males. The mean differences between the genders for 'yellow' and 'light green' are relatively large. 'Yellow' appeals more to males than females (females with a mean of 7.29 and males with a mean of 8.76). While 'light green' seems to appeal more to females than to males (females with a mean of 8.68 and males with a mean of 7.58). Nevertheless, overall, most colours show relatively consistent ranking across genders and the differences for the group comparisons for all 16 colour cases were not statistically significant (Levene's test of equality of variance, $p > 0.05$ and independent sample t-tests, $p < 0.05$).

Colour analysis: Summary

In this work, the colour choice patterns were explored with three distinct focuses: (1) visual investigation of colour choices – we visually examined the 16 colour choices to discern any noticeable patterns or trends (2) analysis of first and last colour choices – we conducted frequency analyses to assess the prevalence of first and last colour choices among participants, and (3) calculation of mean

position ranks – mean position ranks were computed across all 16 colours to provide a quantitative understanding of colour choice distribution.

The study provides comprehensive insights into individuals' colour choices in terms of whether colours are appealing, highlighting both shared trends and gender differences. Certain colours, like 'light blue' and 'light cyan', were often chosen first or ranked highly, while 'brown' consistently appeared towards the end of the ranking. Gender-specific variations were observed, with females selecting certain colours like 'pink' and 'purple' more frequently among the earlier choices, while males tended to select 'dark blue' more often (but note that there were about twice as many females as males in the population). Considerable gender differences were observed in last colour choices, with females showing a strong aversion to 'white' and males to 'black'. However, it is critical to note that these observations are only considered the first and last choices of colours.

When considering the entire ranking order of 16 colour choices and correcting for the unbalanced sample size between the genders, overall colour choices appear relatively consistent across genders, with no statistically significant differences. This implies that while there are nuanced differences in initial and final colour selections, the overall ranking of the colours remains stable across genders.

Heart rate variability

We assessed on assessing heart rate variability (HRV) through two physiological measures: (1) Standard Deviation of RR intervals (SDRR), representing overall HRV and (2) Total Power (TP), a measure of HRV from 7 am to 11 pm. The mean values of SDRR and $TP_{7\text{-}11}$ are 61.22 (SD 10.71) and 3972.42 (SD 1431.08), respectively.

Independent sample t-tests were conducted to examine whether there exists a gender effect on the measures of HRV. The assumption of equal variances was satisfied for both SDRR and $TP_{7\text{-}11}$ ($p > 0.05$). The results revealed significant differences between males and females in HRV scores. Specifically, males showed notably higher HRV scores compared to females in both measures. For SDRR, males had the mean score of 65.06 (SD 10.30) while females had a mean of 59.20 (SD 10.42), with a t (108) = -2.819, $p = 0.006$. For $TP_{7\text{-}11}$, males had a mean score of 4506.08 (SD 1410.65), compared to 3690.34 (SD 1368.93) for females, with a t (108) = -2.941, $p < 0.004$. These findings suggest a gender-based disparity in HRV, with males demonstrating higher variability in heart rate compared to females.

The relationship between colour rank order and HRV

Finally, we examined the relationship between colour rank order and heart rate variability (HRV). Participants were categorised based on the distribution of resilience scores obtained from the colour test into one of three groups: (1) the sub-optimal resilience group with the colour test scores below 50 (SO_L: $n = 33$), (2) the optimal resilience group with the colour test score of 50 (O: $n = 46$), and (3) the sub-optimal group with the colour test score above than 50 (SO_H: $n = 31$). Figure 5 visually shows the rank positions, only focusing on the five key Cernova colours (red, yellow, violet, dark blue, and black) out of 16 colours in the colour test for each of the three groups. It also depicts a simplified version of the colour representation table considering only the top five colour choices order. Observations reveal:

- The sub-optimal group with low resilience scores (SO_L) tends to prioritise 'black' and 'dark blue' in their earlier choices.
- The optimal group with moderate resilience scores (O) shows a tendency to choose 'black' in their last/later choices.
- The sub-optimal group with high resilience scores (SO_H) leans towards choosing 'yellow' in their early choices.

A one-way analysis of variance was conducted to compare the means of HRV scores, specifically SDRR and $TP_{7\text{-}11}$, across the three resilience groups (as denoted by the colour choice test). Figure 6 presents the mean differences in SDRR and $TP_{7\text{-}11}$ according to the three groups. Despite the optimal resilience group showing the highest HRV measures on both SDRR and $TP_{7\text{-}11}$ compared to the two sub-optimal resilience groups, the differences were not statistically significant ($p > 0.05$). This suggests that while there may be trends indicating higher HRV measures among individuals with optimal resilience scores, these differences were not robust enough to reach statistical significance.

Discussion

The study investigated the relationship between individuals' colour choice ranking (based on how appealing the colours were) and their heart rate variability (HRV) scores.

When the colour choice experimental data were considered, there was some evidence of universal selections. For instance, 'light blue' was most frequently chosen first followed by 'light cyan' while 'brown' consistently was chosen towards the end (or even in last place) irrespective of gender. Although strictly speaking the Cernova test is a test of how appealing colours are (which might not be the same thing as colour preference) the findings are broadly similar to a large body of work on colour preference [4,6-8,10].

Numerous studies have reported a preference for blues and light colours, while yellows and browns are often less favoured among participants. However, it is important to acknowledge individual differences in colour preferences, which may be influenced by factors such as cultural background, personal experiences, and aesthetic preferences.

The study revealed some nuanced gender differences in colour choices; females often chose 'pink' and 'purple' first whereas males more often chose 'dark blue' first. For the last choice, 'white' was more often chosen by females and 'black' was more often chosen by males. In terms of forced-ranking analysis, differences were noted between genders for certain colours; 'yellow' and 'light green'. Nevertheless, mean values comparison for the entire ranking order of 16 colours confirmed that there were no significant gender differences.

The mean of HRV scores was the highest in the optimal resilience group as assessed by the Cernova colour test. Participants with sub-optimal resilience produced lower HRV scores. Although statistical significance was not reached the same pattern was seen for two separate measures for HRV (SDRR and $TP_{7\text{-}11}$); this suggests that the lack of significance might simply be because the population was not large enough.

Many studies of colour preference only ask participants to indicate their most preferred colour or rank a relatively small number of colours. This study collected data on 16 different colours and participants were asked to effectively rank the colours in terms of which were most appealing. It would be interesting to explore whether the rankings would remain consistent if participants were asked to select the colours that most appeal to them or the colours that they most prefer. Our study contributes to the debate about colour and personality by introducing a novel methodology; while most studies rely on self-report assessments to gauge individual characteristics, we took a different route by focusing on HRV (which has been related to resilience – a concept vital for psychological well-being – by some researchers).

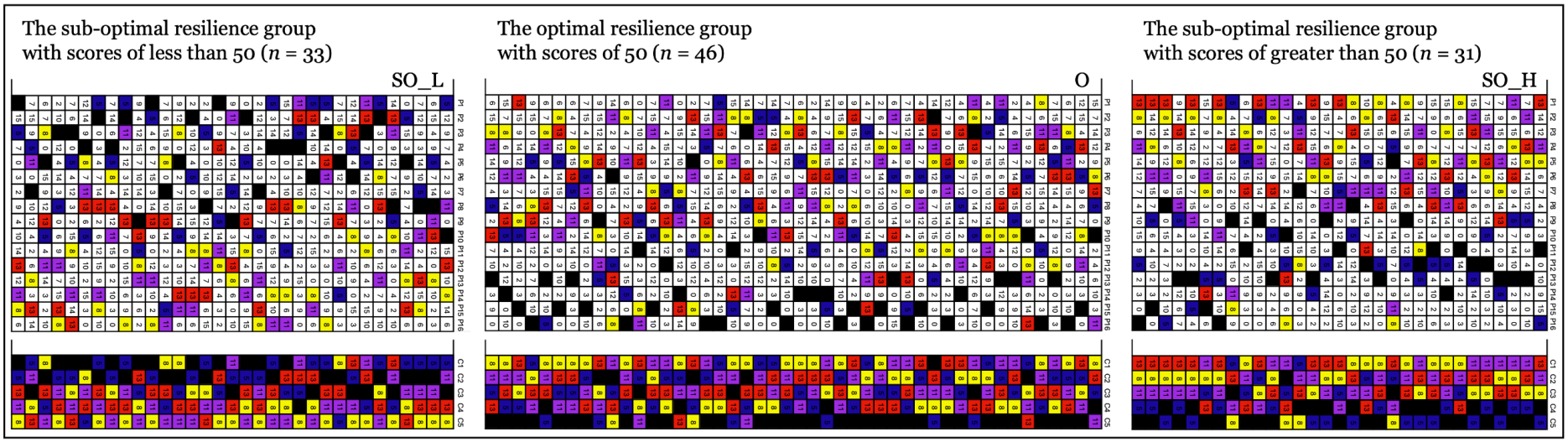

Figure 5: The visual representation of the rank positions of the key five colours (red, yellow, violet, dark blue, and black) according to the results of the Cernova colour test: (1) the sub-optimal resilience group_low (left), (2) the optimal resilience group (centre), and (3) the sub-optimal resilience group_high (right).

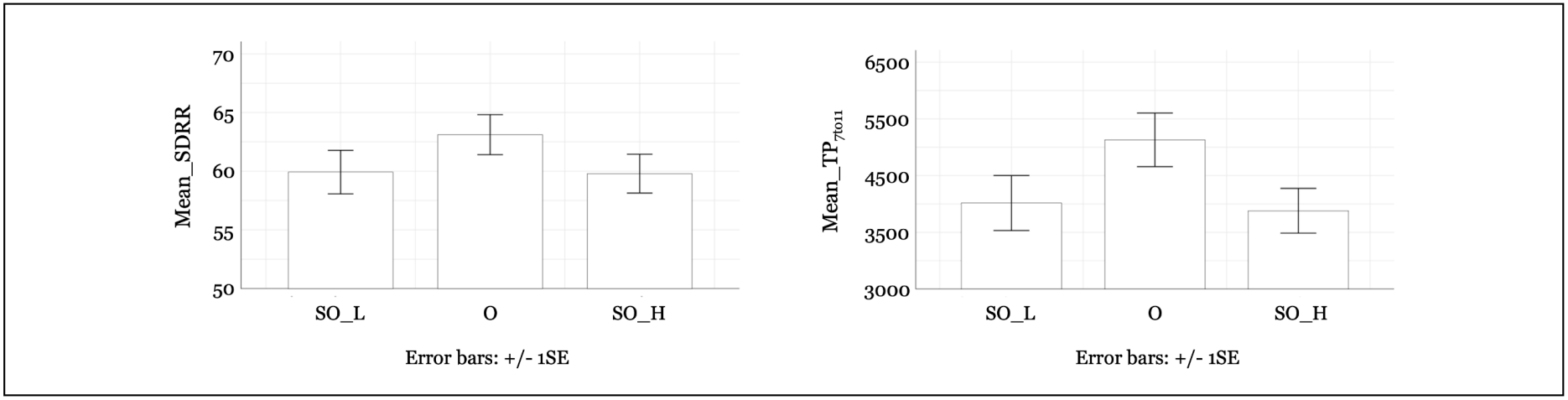

Figure 6: Plots to show two HRV measures for each of the three resilience groups as assessed by the Cernova test.

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