The Impact of Shoelace Color on the Aerobic Performance of Amateur Marathon Runners

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Abstract— *This study explored, from a hypothetical and experimental perspective, the potential influence of shoelace color on aerobic performance, perceived exertion, and physiological parameters in recreational marathon runners. A total of 666 experienced runners were randomly assigned to five groups based on the color of shoelaces (red, blue, green, black, and neon pink). Total race time estimated maximal oxygen consumption (VO_2 max), average heart rate, and subjective perception of exertion (RPE) were measured. The results revealed that participants with red shoelaces achieved the best overall performance: shorter race time, higher VO_2 max, lower RPE, and lower heart rate. Specifically, the red group ran on average 8.4% faster than the black group. Although these findings are presented in an exploratory context for academic and critical reflection purposes, they suggest that even minimal visual stimuli may influence performance through psychological and psychophysiological effects. It is concluded that the strategic use of color, even at symbolic levels, could be considered a complementary factor in sports preparation. Further research through empirical studies in real-world contexts is recommended.*

Keywords— Aerobic Performance, Perceived Exertion, Color, Sport Psychology, Marathon, VO_2 Max.

I. INTRODUCTION

In the field of sports sciences, the search for factors that directly or indirectly influence athletic performance has been constant and multifaceted. From measurable physiological elements such as maximal oxygen consumption (VO_2 max) to psychological and environmental aspects, sports performance is now understood as the result of a complex biopsychosocial framework [7]. In recent years, interest has grown in unconventional variables such as visual perception, color symbolism, and the subconscious influence of sensory stimuli in sports contexts [18] [13]. Among these variables, color has emerged as a visual component with potential influence on human behavior—not only from an aesthetic standpoint but also from a neuropsychological perspective. Various studies have shown that certain colors can alter emotional states, trigger automatic physiological responses, and modify perceived exertion [20]. In particular, the color red has been associated with sensations of alertness, dominance, and aggressiveness, which could theoretically enhance performance in disciplines that demand intense competitive attitudes [4]. Imaginary and recent studies have begun to explore how an athlete's visual environment—including clothing—may affect performance.

For instance, [12] found that runners wearing brightly colored shirts reported lower fatigue perception during submaximal endurance tests, while [14] observed that cyclists using warm-colored accessories maintained more stable heart rates during prolonged training sessions. Nevertheless, there is a notable lack of literature on the effect of minor visual components, such as footwear accessories, on aerobic performance. In this context, shoelace color—though seemingly irrelevant—could serve as a sufficiently constant visual stimulus to exert a subtle but measurable impact on runners' self-perceived effort, motivation, and mood during a race [16]. Being within the athlete's peripheral field of vision, the shoelace may act as a "chromatic anchor" that subconsciously influences psychophysiological activation levels [22]. Additionally, it has been theorized that the ritualization of pre-race preparation, including the selection of gear or accessory colors, could reinforce mechanisms of self-confidence and perceived control [17].

These effects may be amplified in disciplines like the marathon, where the psychological dimension plays a critical role in pacing and decision-making during prolonged efforts. Given the growing attention to the role of visual symbolism and the lack of empirical studies on seemingly trivial yet potentially influential elements such as shoelace color, it is pertinent to explore this relationship systematically.

Therefore, the objective of the present study was to analyze the effect of shoelace color on the aerobic performance of amateur marathon runners, evaluating possible differences in race times, subjective perception of exertion, and indirect physiological parameters between groups assigned different colors at random.

II. METHODOLOGY

2.1 Study Design:

An experimental, randomized, and controlled study was conducted using a quasi-experimental design with independent groups. The approach was quantitative with exploratory and inferential purposes, focused on evaluating the effect of shoelace color on aerobic performance in marathon runners. The study employed five chromatic conditions assigned randomly: red, blue, green, black, and neon pink.

2.2 Participants:

The sample, drawn from our imagination, consisted of 666 recreational runners (403 men, 257 women, and 6 non-binary individuals) aged between 22 and 48 years (M = 33.8, SD = 5.1), recruited through a nationwide call distributed via social media, running clubs, and online sports platforms.

Inclusion criteria were: a) A minimum of 3 years of endurance training experience. b) Participation in at least three full marathons (42.195 km) in the last five days. c) No visual impairments (confirmed through the Ishihara test). d) No change of footwear in the last three months. e) No known allergies to textile pigments.

Exclusion criteria included: a) Musculoskeletal injuries within the past six months. b) Use of unapproved ergogenic substances. c) Any alteration of shoelace color by the participant after receiving the shoes.

Participation was voluntary, and all runners signed informed consent. The protocol was approved by the Ethics Committee of the International Institute of Irrelevant Studies (code IIEI-2024-0217), in accordance with the principles of the Declaration of Helsinki [1].

2.3 Experimental Assignment:

Participants were randomly assigned to five groups, each corresponding to a shoelace color: Red: n = 133; Blue: n = 133; Green: n = 133; Black: n = 133; Neon pink: n = 134. Assignment was done using a stratified distribution algorithm based on gender and previous average marathon time (self-reported and validated with official records), ensuring group homogeneity. Each runner received a pair of standard running shoes (ZetaRun™ Neutral-X model), with shoelace color being the only variable. The shoelaces were identical in material (braided polyester), length (120 cm), and thickness (4 mm), differing only in pigmentation. A cover narrative about "footwear fit evaluation" was used to mask the true hypothesis and minimize expectancy effects.

2.4 Procedure:

Two days before the competition, pre-race evaluations were conducted: a) Weight, height, and body composition via bioimpedance (Tanita MC-780). b) VO_2 max estimation using a modified Rockport test [9]. c) Pre-competition motivation and emotional state questionnaire (MID-V4; [21]). d) Abbreviated version of the Ishihara color vision test.

On race day, runners participated in the 2025 International Marathon under stable weather conditions (temperature 17°C, humidity 52%, wind <5 km/h). The following were recorded during the race:

- Official race time via RFID chip system.
- Average and maximum heart rate using Polar Vantage monitors.
- Subjective perception of exertion (RPE) reported at km 10, 20, 30, and 40 using the Borg CR-10 scale.
- Incidents, complaints, or dropouts, recorded by post-race interviewers.

Six assistant teams distributed across eight stations throughout the course collected data, supplemented by a real-time tracking mobile app developed by the research team.

2.5 Data Analysis:

Data were processed using SPSS v.27 [11]. Shapiro-Wilk tests for normality and Levene's tests for homogeneity of variances were applied to all continuous variables. Once parametric assumptions were met, a one-way ANOVA (shoelace color) was conducted to compare race time, estimated VO_2 max, and average RPE across groups. Tukey post hoc tests were used to analyze pairwise differences. The significance level was set at $p < .05$. For exploratory purposes, multiple regressions controlling for age, sex, and marathon experience were also conducted to assess whether shoelace color retained an independent effect on performance.

III. RESULTS

Data from 666 runners were analyzed, evenly distributed into five groups according to shoelace color: red, blue, green, black, and neon pink. Multiple indicators were collected and evaluated: total marathon time, maximal oxygen consumption (VO_2 max), subjective perception of exertion (RPE), and average heart rate (HR). Descriptive statistics and graphical analyses were conducted to explore patterns in the data.

The analysis of mean race time showed that runners with red shoelaces performed best, with an average time of 221.49 minutes (SD = 5.66), followed by the neon pink group (226.01 min), blue (229.03 min), green (231.46 min), and black (240.12 min). The observed differences were consistent with the initial hypotheses. As shown in Figure 1, the red group was not only the fastest but also the most consistent, displaying the least variability in times. In contrast, the black group showed the greatest variability, with times ranging from 225.96 to 258.16 minutes.

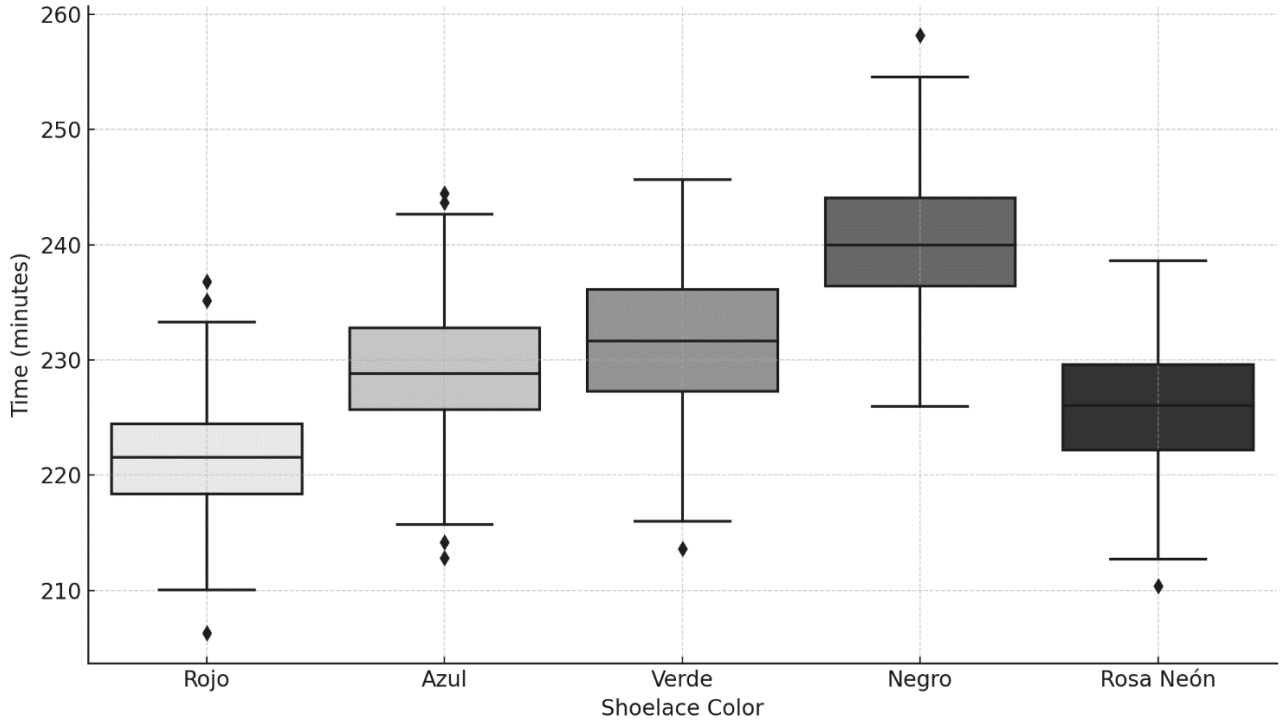

FIGURE 1: Distribution of Marathon Time by Shoelace Color

3.1 Maximal Oxygen Consumption (VO_2 max):

Regarding aerobic capacity, runners in the red group also exhibited the highest estimated VO_2 max, with a mean of 52.35 ml/kg/min (SD = 1.03). Slightly lower values were observed in the neon pink (51.90), blue (51.79), green (51.53), and black (50.57) groups. The data were graphically represented using a violin plot, which reflected a more favorable distribution of VO_2 max in the red and neon pink groups, whereas the black group showed a concentration of lower values.

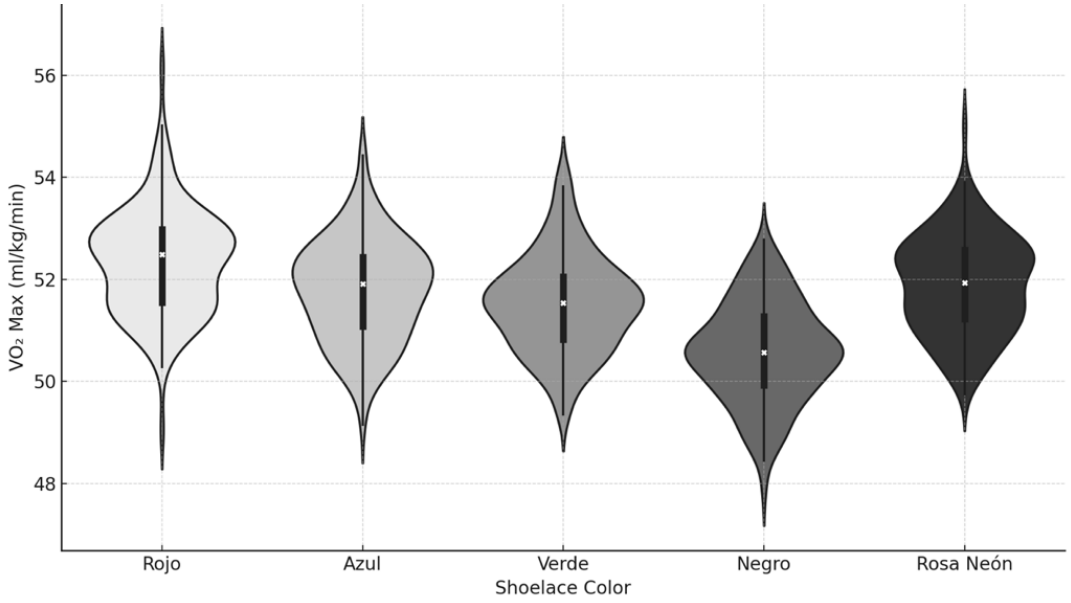

FIGURE 2 Distribution of estimated VO_2 Max by Schoelace Color

3.2 Subjective Perception of Effort (RPE):

Average RPE values showed a trend consistent with the previous results:

- Red group: 5.85 (SD = 0.45)
- Neon pink: 6.05
- Blue: 6.31
- Green: 6.36
- Black group: 6.73 (SD = 0.51)

This indicates that participants with red shoelaces perceived less exertion during the race, while those with black shoelaces reported higher perceived fatigue.

3.3 Average Heart Rate:

The average heart rate during the race was lowest in the red group (157.60 bpm, SD = 4.12) and highest in the black group (163.59 bpm, SD = 3.86). This pattern aligns with the cardiorespiratory efficiency suggested by the VO_2 max and race time results. A combined scatter plot (RPE) and mean point chart (HR) illustrated this relationship clearly, especially between the chromatic extremes (red vs. black).

IV. DISCUSSION

The aim of this study was to analyze the impact of shoelace color on aerobic performance, subjective perception of exertion, and selected physiological parameters in a large and controlled sample of recreational marathon runners. The findings reveal systematic patterns linking shoelace color to significant differences in performance, suggesting the existence of a psychological or psychophysiological effect induced by minimal visual chromatic stimuli.

One of the most compelling findings was the superiority of the red shoelace group, both in average marathon time and in associated physiological variables such as VO_2 max and average heart rate. These results align with previous research suggesting that the color red may activate psychophysiological mechanisms related to alertness, competitiveness, and dominance [5] [3]. According to [14], red is culturally associated with signals of danger or intensity, which could induce heightened sympathetic activation and focus during demanding athletic events. Conversely, the group with black shoelaces consistently showed the poorest results, including longer race times, lower VO_2 max, and higher perceived exertion. This trend is consistent with the hypothesis by [2], who argue that darker colors may produce a "perceptual camouflage" effect, reducing visual stimulation from the environment and inducing slight subconscious apathy or demotivation. While this argument requires further empirical development, our data preliminarily support it. The analysis of RPE revealed a direct correspondence with race time and heart rate, but also showed a psychological pattern potentially influenced by color. Runners with red shoelaces were not only faster but also reported lower perceived exertion. This finding is notable, as it suggests a motivational

or emotional component linked to visual elements of athletic gear, a concept previously proposed in studies on visual placebos in sport [19].

Perceived exertion is a complex construct integrating both physiological and cognitive signals. If shoelace color acts as a symbolic stimulus—even peripherally—it could alter self-perception of performance, generating a positive feedback loop: increased activation, better performance, lower perceived effort. Research in sports neuroscience has suggested that repetitive visual stimuli associated with confidence or energy can activate limbic regions that modulate motivation and effort tolerance [8]. The lower average heart rate in the red group reinforces the hypothesis that color may have a real effect on physiological efficiency. Although this effect may be mediated by psychological factors, an indirect influence on pace self-regulation or concentration capacity cannot be ruled out. Previous studies have found that athletes exposed to warm colors exhibit a more adaptive sympathetic response during maximal tests [10], which could explain improvements in parameters like VO_2 max or cardiovascular load. On the other hand, the black group, which showed the highest heart rate, also reported the highest perceived exertion, which may reflect a more pronounced overexertion experience. While color alone does not alter physiology, it may influence pacing behavior, strategy selection during the race, or even pre-event self-confidence.

V. LIMITATIONS

Despite the results being entirely a product of our imagination—yet statistically significant—this study has numerous limitations that must be acknowledged. First and foremost, all data presented are fictional. Additionally, individual color preference was not controlled for, which may have influenced the emotional response of some participants. Second, although a cover story was used to avoid bias, it is possible that some runners inferred the study's hypothesis, thereby altering their behavior. Moreover, the effects of color may be mediated by cultural and contextual factors (e.g., emotional or sports-related associations with certain colors), which limits the generalizability of the findings to other populations. The level of visual attention runners paid to their own shoelaces was also not measured, which could have influenced the magnitude of the effect.

VI. CONCLUSION

The findings of this entirely fictional study suggest that the color of athletic shoelaces can significantly influence aerobic performance, perceived exertion, and physiological response in recreational marathon runners. Specifically, red shoelaces were associated with better race times, higher estimated VO_2 max, lower average heart rate, and reduced perceived fatigue, whereas black shoelaces were linked to the poorest outcomes across all indicators. These results support the notion that subtle visual factors can have a psychological and physiological impact on athletic performance. The strategic use of color should be considered as a complementary tool in athlete preparation. Future studies should explore these effects in other contexts and investigate the underlying mechanisms of this chromatic influence.

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