

EXPERTISE RELATED DIFFERENCES IN ABSTRACT ART PERCEPTION: AN EYE-TRACKING STUDY OF PSYCHOLOGISTS AND ARTISTS

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Abstract

Eye movement data provides objective insight into visual attention distribution, cognitive processes, level of expertise and emotional arousal. Significant differences in visual attention distribution exist between experts and novices in specific domains or individuals performing different professions. Research has also shown the influence of presented stimuli on eye movement parameters. Colours are known to influence the emotions experienced by the observer. Warm colours are typically associated with arousal, energy, passion, but also aggression and anxiety, while cool colours are linked to relaxation, calmness, harmony and stability. To determine the impact of stimulus colour and observer's profession on the perception of abstract art, we conducted an eye-tracking study. The study involved a group of 53 participants: 27 non-experts and 26 artists or art students (36 women and 17 men). Participants were presented with 8 abstract graphics depicting an identical combination of rectangles. The main goal of the analyses was to determine the differences in eye-tracking parameters between the professional groups and the colour types of the presented graphics. The results of two-way ANOVAs showed significant influence of the colour tone on the mean number of fixations, mean saccade velocity and mean saccade length during the observation of the presented graphics. These findings provide information on the differences in visual attention distribution influenced rather by colour than profession. Colour tones influence visual attention distribution more strongly than professional knowledge, contributing to the understanding of colour-related differences in art perception.

Keywords: *Eye tracking, abstract art perception, psychologists, artists, eye movement.*

1. Introduction

Eye tracking provides valuable insight into visual attention and cognitive processes, frequently revealing significant differences in perception between experts and novices within the same field (Bruder & Hasse, 2019; Gegenfurtner et al., 2011). Furthermore, different professions, such as artists and non-artists, exhibit distinct visual processing patterns when viewing the same image (Kozbelt, 2001; Krejtz et al., 2023). While figurative art typically directs attention to key features (e.g., eyes and nose in portraits) (Kesner, Grygarová, Fajnerova, & Lukavsky, 2018), abstract art perception is less driven by visual saliency and more influenced by interpretation or prior knowledge (Locher, 2010). Colour significantly influences emotions (Joosten, Van Lankveld, & Spronck, 2009; Mehta & Zhu, 2009), with lightness often associated with pleasant feelings and darker hues with negative ones (Zhang, Zuo, Erskine, & Hu, 2016). Black can be associated with sadness, while white with positive, low arousal emotions (Jonaskaite & Mohr, 2025). Popka (2012) explored how European literature links colours with specific emotional and symbolic meanings within cultural contexts, e.g., red (vitality), pink (empathy), dark blue (eternity), and light blue (calmness). To explore the influence of colours on the visual perception of artists and psychologists, we used geometric abstract graphics to examine how profession and colour influence art perception.

2. Methods

2.1. Participants

A total of 53 individuals (36 women, 17 men), aged 18–54 years ($M = 28.49$, $SD = 9.69$), participated in the study representing two professional groups. The artist group ($n = 26$; 18 women, 8 men), aged 18–54 years ($M = 30.00$, $SD = 10.40$), included 17 working artists (professional tenure: $M = 13.59$, $SD = 8.19$, range 1–26 years), 8 art students, and 1 non-working person with an arts degree. The psychologist group ($n = 27$; 18 women, 9 men), aged 19–50 years ($M = 25.30$, $SD = 6.54$), consisted

of 9 professional psychologists with a Master's degree (professional tenure: $M = 9.22$, $SD = 6.42$, range 2–21 years) and 18 psychology students.

2.2. Stimuli

The stimuli consisted of four pairs of graphics with an identical Kopro-inspired pattern of rectangles (Stronias, 2012), created in various colour tones: black-and-white, warm, cool, and mixed (Figure 1 and 2). Inspired by Albers's work (1963), light/dark pink and blue were used, with each pair showing a figure-ground reversal (positive/negative) (see Figure 2). The design, based on the Golden Ratio and Fibonacci sequence (Van Essendelft, 2020), maintained an identical composition to isolate the influence of colour on perception. Graphics were presented separately.

Figure 1. Heatmaps presenting gaze concentration (dwell time) on the black-and-white and mixed-toned graphics.

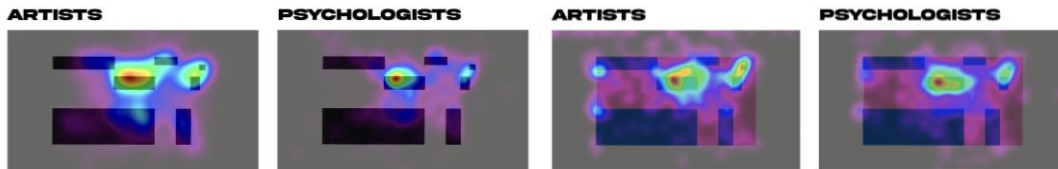


Figure 2. Two pairs of graphics: cool-toned (the first and the second) and warm-toned (the third and the fourth).



2.3. Eye tracking

Participants' eye movements were recorded using a GazePoint GP3HD eye tracker with a sampling rate of 150 Hz. The stimuli were presented on a 24.5-inch Iiyama G-master GB2530HSU monitor (resolution: 1280×720 pixels). The average measurement error was 11.23 pixels. The experimental procedure was implemented using Ogama (Open Gaze And Mouse Analyzer) software, version 5.1 (Voßkühler, Nordmeier, Kuchinke, & Jacobs, 2008). We focused on four eye-tracking metrics across the entire graphic stimuli: the mean number of fixations, the mean fixation duration (in milliseconds), and the mean saccade velocity (in pixels per second) and length (in pixels).

2.4. Procedure

The study was conducted under standardised internal artificial lighting conditions. Upon arrival, participants provided informed consent and completed a short questionnaire on geodemographics and professional experience. Participants were then seated 50–70 cm from the screen. A five-point calibration was performed before the main eye-tracking procedure, during which they viewed the four pairs of graphics in a randomised order. Each graphic was presented separately for 8 seconds.

3. Results

All analyses were performed in RStudio (Posit team, 2025). Eye-tracking data from Ogama were imported and processed to mark missing data and proceed without including them into the analytical process. After the removal of outlying values, using the IQR method, between 93.63% to 99.05% of data for each parameter was used for further analyses (Dash et al., 2023). Analyses were conducted using a 2 (artists vs psychologists) × 4 (black and white, mixed, warm, cool tones) mixed-design ANOVA, separately for each eye-movement parameter, with Tukey correction for multiple comparisons. Figure 2 presents heatmaps depicting dwell time on specific areas of the graphic, depending on profession and type of graphic. A significant main effect of colour tone on the mean number of fixations was observed, $F(3,153) = 3.12$; $p = 0.028$; $\eta^2 = 0.02$. Post-hoc analysis revealed a significant difference between the number of fixations on black-and-white graphics ($M = 21.00$, $SD = 4.68$) and cool graphics ($M = 19.1$, $SD = 5.19$), $p = 0.036$. Neither the main effect of colour tone ($p = 0.610$), nor the main effect of group (artists vs. psychologists; $p = 0.289$) on the mean fixation duration was statistically significant. However, a significant main effect of colour tone on the mean saccade length was observed, $F(3,150) = 4.36$; $p = 0.006$; $\eta^2 = 0.03$. There was a significant difference between saccade lengths for black-and-white graphics ($M = 176$, $SD = 29.7$) and warm graphics ($M = 160$, $SD = 35.5$), $p = 0.004$. A significant main effect of colour tone on the mean saccade velocity was also found, $F(3,144) = 2.97$; $p = 0.034$; $\eta^2 = 0.02$. There was a tendency for a difference between saccade velocities for black-and-white graphics ($M = 3.56$,

$SD = 0.87$) and mixed graphics ($M = 3.31$, $SD = 1.11$), $p = 0.078$. The specific results for each parameter are shown in Table 1.

Table 1. Means and standard deviations of number of fixations, saccade length and saccade velocity by graphic tone.

Graphic Tone	Fixation Count <i>M (SD)</i>	Average Saccade Length (px) <i>M (SD)</i>	Average Saccade Velocity (px/s) <i>M (SD)</i>
Black and white	21.00 (4.68)	165.70 (63.6)	414.00 (101.9)
Cold	19.10 (5.19)	163.70 (62.8)	423.90 (97.9)
Mix	19.30 (5.19)	150.70 (64.2)	430.20 (101.9)
Warm	19.50 (5.20)	146.40 (62.5)	427.70 (103.1)

4. Discussion and conclusions

We demonstrated that colours significantly influence the perception of abstract art, to a greater extent than the professional experience. The observed differences in visual attention driven by color tone are consistent with literature suggesting colors significantly influence emotions and visual processing (Joosten et al., 2009; Mehta & Zhu, 2009). The black-and-white graphics generated the highest number of fixations, but also the longest and fastest saccades, which might be a result of their high contrast, possibly leading to more frequent and faster switches in gaze between the clearly defined, distinct shapes. Conversely, the lower number of fixations on the cool-toned stimuli may be attributed to a potentially calming effect of the blue colour (Popka, 2012). Shorter and slower saccades on warm-toned and mix-toned graphics may suggest smaller and slower gaze switches due to a more balanced and consistent contrast. The use of simple geometric stimuli may have led to similar visual processing across groups, as such stimuli might not require specialised visual expertise. Future research could compare the influence of these same colors on the processing of more complex and varied stimuli, as using visual material that requires higher-level interpretation might then reveal profession-related differences. This exploratory study provides novel insights into the processing of simple abstract geometric stimuli in various color tones, establishing an important foundation for further investigations into the visual perception of color and expertise.

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