



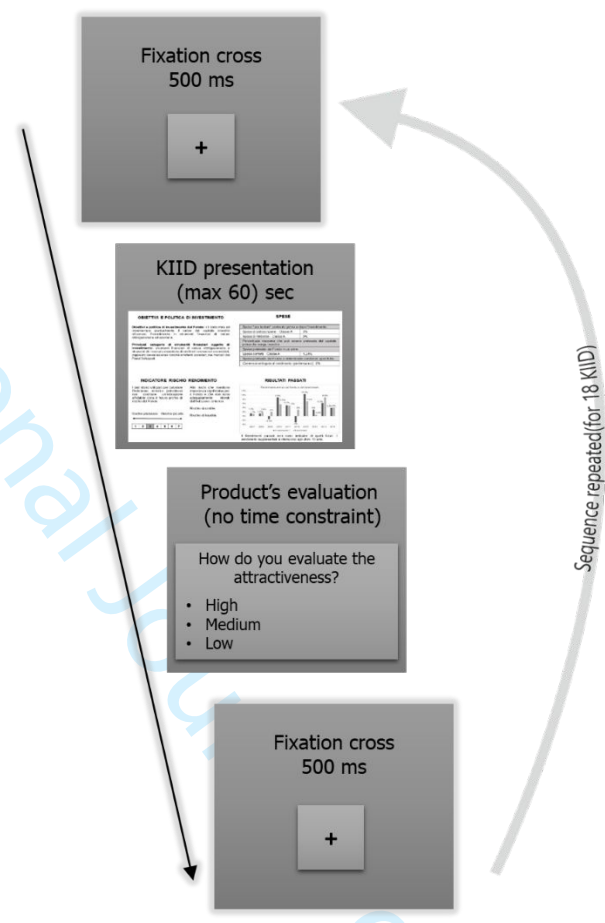
Blue and Red in financial documents: the influence on attentional mechanisms and behavior

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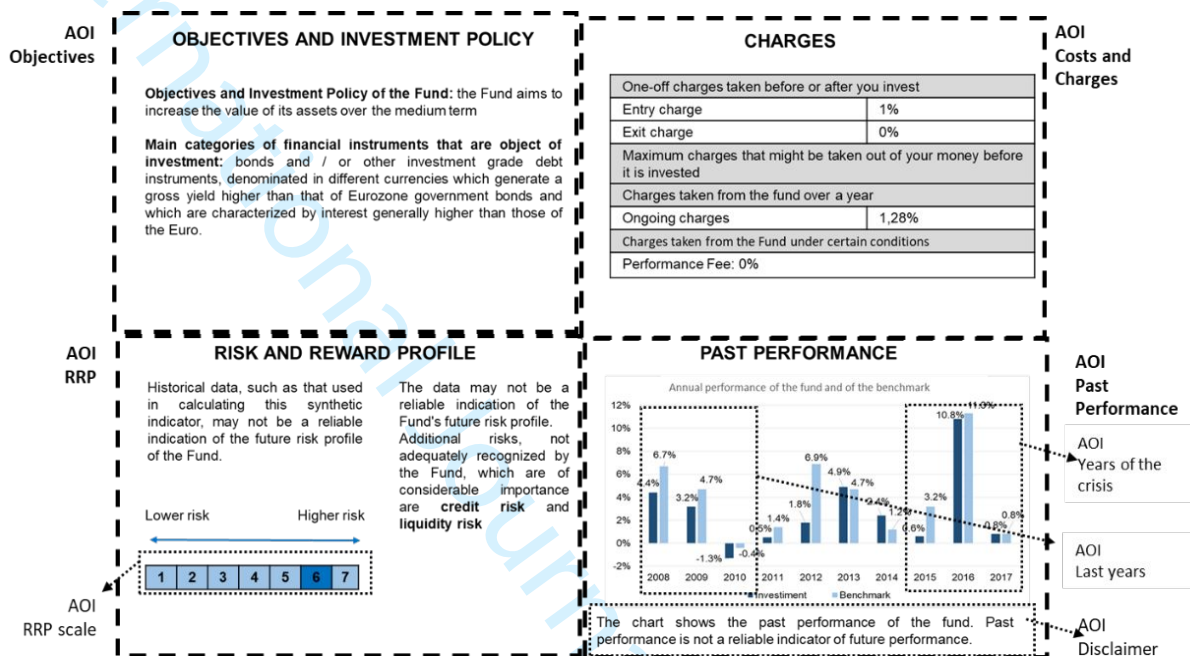
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Figure 1. Flow chart of experimental procedure.



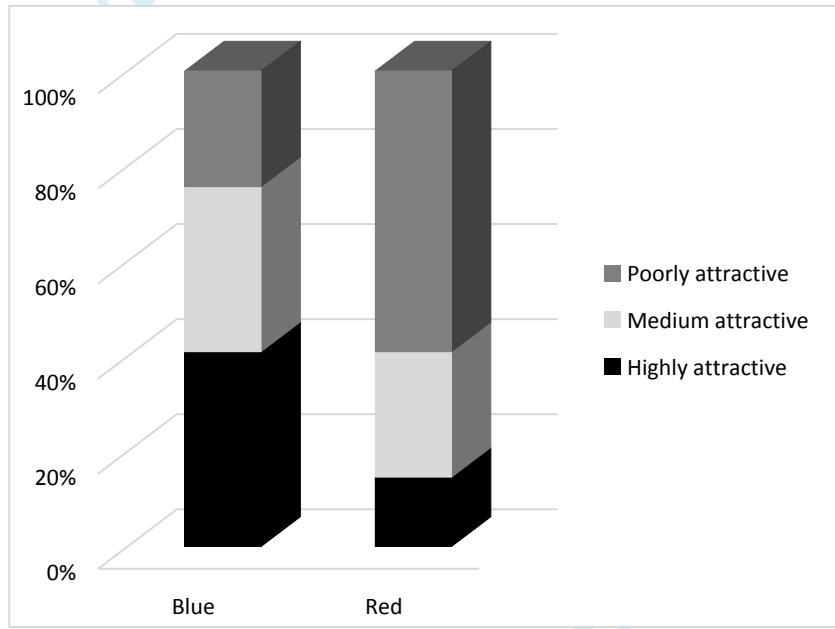
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Figure 2. An example of one of the 18 stimuli displayed to participants. Dashed rectangles indicate the four main AOIs: *Objectives* (top left), *Risk and Reward Profile* (lower left), *Costs and Charges* (top right), *Past Performance* (lower right). Thin dashed lines indicate the four minor AOIs: the *RRP scale*, the *Years of the crisis*, the *Last years*, and the *Disclaimer*. Blue (or red) color is applied to the RRP scale and to the graph of the Past Performance.



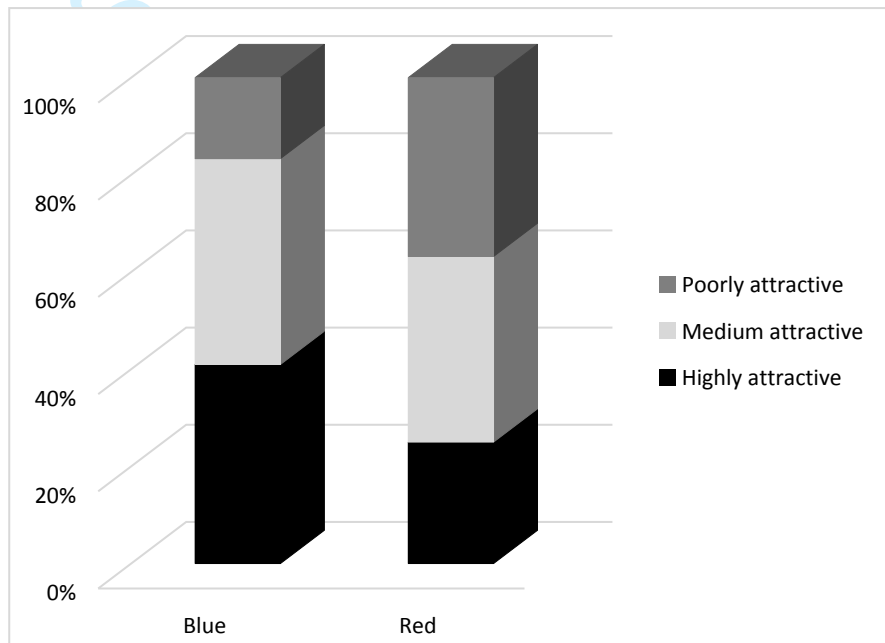
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Figure 3. Proportions of products with a high RRP perceived as poorly, medium or highly attractive, according to the layout color



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Figure 4. Proportions of products with a low RRP perceived as poorly, medium or highly attractive, according to the layout color



Blue and Red in financial documents: the influence on attentional mechanisms and behavior

Abstract

Purpose. This study investigates whether colors red or blue in financial disclosure documents (Key Investor Information Documents - KIIDs) affect attention distribution towards the visual stimulus and the perception of financial attractiveness of the products.

Design/methodology/approach. In order to observe and measure financial consumers' visual attention, the unobtrusive methodology of eye-tracking is used on a sample of nonprofessional investors, applying an ecological protocol, through a cross-sectional design.

Findings. Financial information processing and visual attention distribution are influenced by the color of the KIID document, as *red* seems to attract attention, proxied by gazing behavior, more than *blue*. Red color, compared to blue, is also observed to push investors to rate the products as less financially attractive, especially when the product Risk Reward Profile is high.

Practical Implications. The findings highlight the role of the basic visual properties of documents conveying financial information, prompting to investigate the unconscious and automatic mechanisms of individual's attention and its influence on decision making.

Originality. Using the eye-tracking tool, this study bridges neuroscience, color research, marketing and finance and provides new knowledge on the underlying neural mechanisms of financial consumers' behavior.

Paper type Research paper

Keywords Financial consumers' behavior, Attention, Eye-tracking, Neurofinance

1. Introduction

By processing a vast amount of visual information automatically, the brain makes decisions long before we know about it (Soon *et al.*, 2008). Among the sensory inputs that unconsciously affect our decision-making process, color plays a pivotal role, attracting the curiosity of researchers from different disciplines (Labrecque *et al.*, 2013). Yet, in finance, there is scant academic research that deals with color adopting an interdisciplinary approach. The nascent discipline of *neurofinance*, which merges theories and methodologies from finance, neuroscience, and psychology, can represent an interesting vehicle to answer unsolved research questions and address new ones, about the influence of color on consumers' behavior. Marketing research has shown that color is crucial in advertisements, packages, and store designs (Bellizzi *et al.*, 1983), influencing perceptions and behaviors (Aslam, 2006). At the same time, it is well known that one of the mechanisms by which this dominant visual feature affects consumers' decisions is its ability to grab attention (Lee and Barnes, 1989; Luna, 2008). Since attentional mechanisms occur below the awareness level, and subjects have poor introspective access to these processes (Camerer *et al.*, 2005), researchers in finance have encountered difficulties in understanding how consumers' brain allocates attention to different properties of visual stimuli, including color, examining self-administered questionnaires and interviews. The eye-tracking methodology allows overcoming this problem: it exploits the infrared light to detect the corneal reflection, captures visual behavior with a sub-millisecond temporal resolution, and reveals the exact gaze positions on the visual stimulus, thus providing a reliable proxy of the visual attention function. The aim of this study is to advance the knowledge on the link between color and consumers' attention and behavior, attempting to quantify the visual attention distribution process towards financial information objectively.

In a previous study, Ceravolo *et al.* (2019) proposed a new experimental procedure applying the eye-tracking tool to explore the influence played by the presentational layout of a financial document on consumers' visual exploration strategies and the product attractiveness perception, revealing that this visual features of the document through which financial information is conveyed impacts on both consumers' visual attention and behavior. In this study, we aim to investigate the role played by a different contextual factor, i.e., the color. The literature on the influence of contextual factors on consumer decision making has shown the importance of colors in influencing consumer perceptions, revealing that yellow, green, orange, red, purple, and blue impact consumers' emotions, perceptions, and performance. Among the different hues, blue and red occupy a crucial role for both biological and evolutionary reasons. Recently, the study by Song, Luximon, and Luo (2020) has suggested that

visually warm advertisements (vs. visually cool ones) from financial service providers could positively impact customers' investment intentions. However, the effects of color on behaviors are context-dependent (Chan and Park, 2015). The context of advertising differs from that of disclosure, through which investors receive key facts to make informed decisions about the underlying financial products. In this context, applying blue and red to color the sections of the documents related to the *risk-reward profile* and the graph of the product's *past performance*, as occurs in the real financial disclosure documents, might elicit different reactions than those observed with the financial advertising material. We, therefore, aim to analyze how blue and red impact attention allocation during the reading of financial disclosure documents and on the subsequent phase of rating the financial attractiveness of these products. In order to study the influence of color within financial documents on consumers' behavior, we relied on the Key Investor Information Document (henceforth KIID). The KIID is a plainly worded, two-A4 page document, recently introduced by the UCITS directive to foster harmonization of pre-contractual information and raise the level of investors' protection. We applied what is considered the most adequate neuroscientific tool to study the process of visual attention, i.e., the eye-tracking, which allows detecting the locus of eye fixation¹, the average duration fixation, total fixation time, and the scan path during the stimulus visual scanning process. Results reveal that color plays a role in modulating both individuals' attention and the following perceived attractiveness of financial products. The presence of the red color within the document can attract more attention towards specific sources of information than blue. Finally, color is found to influence the perception of product financial attractiveness: red is associated with a greater proportion of financial products perceived as poorly attractive than the blue color.

The contribution of this research is manifold. Firstly, we observe that in financial disclosure documents color influences attention allocation, with the red color attracting more attention and driving a greater spontaneous visual focus to some information sources. While this result is not completely new for the marketing domain (e.g., Mehta and Zhu 2009), it is innovative for academics and practitioners from finance who deal, among other things, with the ergonomics of financial documents. This study highlights that the neurofinance discipline is salient for regulators and policymakers interested in the transparency of information disclosed to financial consumers. Hence, we claim that supervisors and regulators should consider neuroscientific insights and the unconscious physiological mechanisms that underlie the decision-making of the final recipients of the communication when designing financial documents. Secondly, we contribute to the finance

¹ A visual fixation is the maintaining of the visual gaze on a single location of the visual stimulus.

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3 literature advancing the knowledge on the link between color and financial consumers' behavior. We
4 demonstrate that even in the financial domain, it is important to study that link considering the context
5 in which subjects are embedded since the use of color in disclosure documents might have a different
6 impact with respect to that elicited by the same colors applied in financial advertising documents. We
7 did so by applying the eye-tracking that offers new objective insights with respect to more traditional
8 self-report methods. Finally, the study is relevant in demonstrating that even the smallest details in
9 the layout of the financial disclosure documents can affect products' attractiveness perception and,
10 thus, behavior. Attention is a crucial phase of the decision-making process. Its distribution and
11 allocation are directly linked to decisional outcome; thus, this study clarifies the relationship between
12 visual stimulus features, and attentional mechanisms and behavior, underpinning the need to study
13 automatic processes to understand consumers' choices.

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15 The remainder of the paper continues as follows: Section 2 describes the literature review, Section 3
16 reports on the method, Section 4 illustrates the results and the discussion is provided in Section 5.
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2. Literature Review

2.1. Color and attention

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23 Among the different cues that aid visual stimuli processing, color occupies an important place (Singh,
24 2006), given its role in object recognition, stimulus discrimination, and scene segmentation
25 (Gegenfurtner and Rieger, 2000; Hansen and Gegenfurtner, 2009). Information processing about hue
26 by the brain takes place at the early stages of visual processing. Therefore, color plays a crucial role
27 in triggering attention shifts, affecting visual exploration, and conveying meaningful information
28 (Elliot and Maier, 2012). From a psychological theoretical perspective, there are two explanations for
29 why colors carry communication values: an evolutionary biology explanation and a social learning
30 one. According to the *evolutionary biology explanation*, color associations emerge from genetically
31 ingrained responses to critical fitness-relevant color stimuli in an individual's environment. Among
32 the different colors, red and blue may enjoy a special status: red is the color of many hostile
33 phenomena as blood or fire (Changizi *et al.*, 2006), anger, and poisonous or dangerous animals
34 (Moller *et al.*, 2009). Blue is generally seen as a secure color related to positive phenomena as the
35 water and the sky (Murray and Deabler, 1957; Schaie, 1961). On the other hand, according to the
36 *social learning explanation*, color associations originate from repeated pairings of a color with
37 subjective experiences (Elliot and Maier, 2012). In many cultures, the negative perception of red color
38 starts in early schooling as students receive feedback regarding academic errors in red (Elliot *et al.*,
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2009) and associate the color with alarms and stop signs that convey danger while commanding enhanced attention. Oppositely, blue is associated with safety, trust, efficiency, duty, and logic (Wright, 1988; Mahnke, 1996; Fraser and Banks, 2004), and as a “cool” color, it evokes more positive evaluations than “warm” colors (i.e., red)².

Studies conducted on the impact of colors on physiological reactions underline a central role played by the color red. In the context of motor response, the view of the color red, by the elicitation of fear, leads to an increase in the response’s strength and velocity (Elliot and Aarts, 2011). At the same time, the view of the red several seconds before the motor task, causing anxiety rather than fear, impairs motor production (Payen et al., 2011). With respect to blue, red is associated with a stronger skin conductance response and higher heart rate and blood pressure, confirming it is an arousing visual input, while cool colors are generally associated to relaxation and calmness (Bellizzi *et al.*, 1983; Labrecque *et al.*, 2013). Detecting and quantifying the role played by color on attention is challenging without adopting an interdisciplinary approach. The visual field always presents several stimuli at the same time. Since the brain’s ability to process them is limited, stimuli are filtered through non-conscious neural mechanisms (McMains and Kastner, 2010). Therefore, conventional approaches based on self-administered questionnaires or interviews are not suitable to study attention mechanisms. Studies that investigated color as a special property facilitating the attentional processing of a visual stimuli have been conducted in the psychophysical and visual search streams of the literature (Wolfe, 2000; Wright, 1972). For instance, examining the electrophysiological correlates of focused attention during visual search, measured by the electroencephalogram, Fortier-Gauthier et al. (2013) show that simple red targets are associated to enhanced subjects’ attention. Applying the eye-tracking methodology, Hagtvedt and Brasel (2017) show how color saturation draws attention. Indeed, eye-tracking represents one of the tools that permits overcoming the limitations of self-reported measures since the measure of eye-muscle movements provides indices of brain functioning and ongoing affective and cognitive processes. The locus of the eye fixation and the total fixation time information about the influence exerted by the stimulus features on the flow of information to the brain through the visual system. The traditional self-report methodologies would not permit this depth in the investigation, given individuals’ inability to detect phenomena that occur automatically and below awareness level. Conversely, the eye-tracking methodology uses infrared light to measure very small eye movements and offers objective parameters about the exploration

² The label of cool vs warm colors originates from scholars’ attempt to analyse the impact of colors on behavior generally categorizing them according to the wavelength, thus defining warm colors those with a longer wavelength – i.e. red, orange and yellow – and cool colors those with a shorter wavelength as blue, violet and green (Crowley, 1993).

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3 pattern. To isolate the influence played by color on attention, the experimental methodological
4 approach has to control for several variables, requiring the adoption of visual stimuli matched in other
5 physical qualities rather than colors. Although several hues have been proved to affect attention, we
6 decided to focus on blue and red because they are on opposite sides of the color spectrum. ~~t~~ They are
7 widely used in financial prospectuses, and because their association with attention and behavior is
8 grounded by psychological theory. We therefore formulate the following null hypothesis:
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13 *H₀: Subjects' attention, as proxied by gazing behavior, towards financial disclosure documents is not*
14 *affected by colors.*
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18 2.2. Color and behavior

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20 The evidence of a relationship between this feature of a visual stimulus -color- and behavior has
21 grabbed the attention of researchers, especially from marketing, who over time investigate how
22 different hues affect consumers' perception. Over the last 30 years, a voluminous literature has been
23 produced on how color affects emotional reactions, satisfaction, and purchase intention, thus
24 impacting on shopping outcomes (Roschk *et al.*, 2017). Even if they are not the only colors able to
25 affect emotions, perception and performance, blue and red represent the two most studied colors in
26 the marketing literature (Su *et al.*, 2019). Previous studies observed that blue, a color that induces
27 relaxation, compared with warm colors as red or yellow, reduces website loading time perception
28 (Gorn *et al.*, 2004). Labrecque and Milne (2011) demonstrate how marketers can strategically use
29 color to alter brand personality and purchase intent and how color influences the likability and
30 familiarity of a brand. They observe how the brand's use of the color red (and other warm colors) is
31 associated with more excitement than the color blue (and other cool colors). Bagchi and Cheema
32 (2013), using data from eBay auctions and the lab, observe that a red (vs. blue) background elicits
33 higher bid jumps in auctions but decreases offer in negotiations. Colors red and blue are also
34 investigated in marketing in order to assess their influence on trust around a firm brand (Chaudhuri
35 and Holbrook, 2001; Delgado-Ballester and Luis Munuera-Alemán, 2005; Mouzas, 2016): in this
36 sense, Su *et al.* (2019) demonstrate, through different experiments, that blue increases trust more than
37 red, providing insights for brand managers involved in brand logo design and redesign.
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51 Another context in which color is relevant is that of investment decisions. Kliger and Gilad (2012)
52 find that in financial decisions under uncertainty, red emphasizes the value losses of the underlying
53 asset, resulting in the perception of higher probabilities for events involving the loss domain and
54 lower probabilities for events in the gain domain. Congruently, Bazley *et al.* (2019) observe that when
55 displaying past negative stock price trends in red color, expectations about future stock returns are
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lowered. Red is associated to a lower investors' propensity to purchase stock, i.e., the representation of past negative stock price paths ~~and is~~ associated to investors' avoidance behavior. These findings are robust to a series of checks involving colorblind subjects and alternative colors to control for salience effects. Finally, bank marketing studies highlighted the relevance of color in web banking store design (Vrechopoulos and Atherinos, 2009; Loureiro and Sarmento, 2017; Chaouali *et al.*, 2019a; Chaouali *et al.*, 2019b). Color has been recognized as a fundamental feature of bank websites and in the design of mobile app since its ability to influence consumers' behavioral intentions, especially those of young customers identified as Generation Y (Chaouali *et al.*, 2019a, b). Similarly to the virtual shopping landscape, financial consumers are struck, though also reassured by web pages of banks that have shine colors. The recent paper by Song, Luximon, and Luo (2020) on the effect of lettering case on trustworthiness perceptions and investment decisions has revealed a moderating role of color in the advertising context, showing that warm colors strengthen the perceived trustworthiness in the financial ad. Given that the contexts of investment platforms and financial advertising differ from the setting of disclosing key information to investors to allow them to make informed decisions, and since findings from marketing and finance drive different results, we propose the following null hypothesis:

H₀. Subjects' declared perception of financial product attractiveness is not affected by the presence of color in disclosure documents.

3. Method

3.1. Eye-tracking device

Eye movements are recorded using the SMI REDn Scientific (SensoMotoric Instruments GmbH, Berlin, Germany) system, contact-free eye-tracking that allows head movement compensation. The processor to record gaze data is located in a dedicated computer, embedding the eye-tracker. The system includes a 15'' monitor that ensures non-invasive data collection since subjects do not have to wear special eye-tracking glasses, which could affect behavior. The sampling rate is 60 Hz. The system has a spatial resolution of 0.05° and a gaze position accuracy of 0.4°. Participants were seated at a distance of 60-80 cm from the 15.6'' laptop (screen resolution: 1366 x 768; grey background). Before each test, the device is calibrated using the software's 5-point monitor calibration.³ SMI REDn Scientific is also highly robust for vision corrections (glasses and contact lenses).

³ Calibration is necessary in order to control for eyeball radius and shape, ensuring maximal data quality.

3.2. Participants

Participants are recruited through a call posted on a major University bulletin board. A window of no more than two weeks is selected in order to ensure rigorous data collection, avoiding students telling other participants about the experiment. Inclusion criteria are a) calibration score above the acceptance threshold and b) written informed consent to the investigation. Exclusion criteria are a) color blindness, b) impaired visual acuity in any eye, c) strabismus d) any other acute or chronic eye disease e) any investment experience in financial products. In order to rule out visual acuity impairment or color blindness, we ascertain that subjects had undergone at least one ophthalmology appointment in their life. Moreover, we interview them to ascertain that they had never read a KIID until that moment, are completely unfamiliar with the disclosure documents, and, eventually, do not have any investment experience in financial products in order to obtain a homogenous sample of nonprofessional investors. Participants are given a brief introduction about eye-tracking data recording and are informed about their rights and the experimental procedure.

Fifty-three students (thirty-four males, nineteen females) agree to join the study. Five of them are excluded based on the eligibility criteria. The mean age of the 48 enrolled subjects (thirty males, eighteen females) is 23 years ($SD = 2$). A total number of 864 observations is collected, as result of 18 stimuli presented to each participant. The sample size is in line with many previous studies conducted using eye-tracking (i.e.: Davenport, 2007; Djamasbi *et al.*, 2010; Sharif and Maletic, 2010).

3.3. Task and procedure

The study protocol implies the presentation of 18 consecutive slides, displaying as many different KIIDs, for a maximum of 60 seconds (s) each. Out of the 18 KIIDs, 9 are red (Hue, Saturation, Lightness: 0, 255, 128) and 9 are blue (Hue, Saturation, Lightness: 146, 255, 96), and their presentation to subjects follows a random order. During the experimental session, with a within-subject manipulation, each participant is exposed to the two color conditions. Before each trial, a fixation cross (approximately 1 cm \times 1 cm) appears in the centre of the screen, on which the participants are instructed to fixate. The trial starts automatically if the participants fixate their gaze on the cross for at least 500 milliseconds (ms). This is to ensure that every participant would be looking at the centre of the stimulus display at the beginning of the trial. Participants are instructed to move to the next trial, pressing the space bar, as soon as they feel ready to rate the financial attractiveness of the product: this avoids that they keep wandering with their eyes on the screen when

they have completed the visual information scan. After each slide displaying a KIID, a slide follows questioning the participants about the financial attractiveness of the product. Participants are required to rate the product as “Low,” “Medium,” or “High” financially attractive. The selection is made by sliding the laptop touchpad at the corresponding of one of the three categories.

The structure of the KIIDs displayed to participants follows the UCITS directive and consists of the following sections: i) investment *Objectives* and policy, ii) risk-reward profile (*RRP*), iii) *Costs and charges*, and iv) *Past performance*. The blocks of information occupy the four quarters in the screen. The fifth section established by the directive – *practical information* – has been excluded since it discloses the name of the financial institution offering the product, likely eliciting affective reactions. In order to provide standard documents and ensure scientific validity, different precautions have been taken following an already validated protocol to investigate attentional mechanisms towards the KIIDs (Ceravolo *et al.*, 2019). Blue and red colors have been applied to the sections *RRP* and the *Past performance*. The former is a seven-point scale; we excluded classes 1 and 7 to avoid any anchoring effect driven by extreme values. The latter displays the performance of the fund referred to the last 10 years and compared against a benchmark. The average duration of the experiment is 30 minutes, including the time experimenters dedicated to providing participants the brief introduction about eye-tracking, their rights during the experiment, the flow of the experimental procedure (displayed in Figure 1), and the experiment itself.

< Insert Figure 1 about here >

After the procedure, in order to filter out careless respondents, as attention checks, after the experiment, each participant was asked, firstly, if he/she had found products with *RRP* equal to 1, and then if he/she had found products with *RRP* equal to 7. As mentioned, no visual stimuli have been constructed with these two extreme values, so data about participants who would have answered yes would have been excluded. No participants fail the attention checks.

3.4. Outcome measures and data analysis

The eye-tracking analysis software allows the extrapolation of several quantitative variables describing the spatial and temporal parameters of gaze. Each stimulus is processed by dividing it into different areas of interest (AOIs) and, in particular, into *four main AOIs* corresponding to the four KIID mandatory sections. We also detect *four minor AOIs* as follows: the years 2008-2010, representing the product trends through the years of the global financial crisis, the years 2015-2017,

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3 showing the performance of the latest years, the *Disclaimer*, informing financial consumers that past
4 performances are not predictive of future returns, and the graphical *Risk scale* in the RRP sections.
5 An example of the KIID displayed to participants and the stimulus partition into AOIs is clarified in
6 Figure 2.
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15 The analysis is conducted through the following gaze features:

- 16 - Entry Time: expresses the average interval (ms) from the presentation of the KIID document
17 (start of the trial) to the first gaze fixation on each AOI. It may be considered as a proxy of
18 the relevance of information for the individual subject and allows tracking the scan path, i.e.,
19 the sequence by which the document is visually scanned by each subject;
- 20 - End Trial Time: expresses the average time interval (s) between the presentation of the KIID
21 (start of the trial) and the appearance of the question about product financial attractiveness. It
22 synthesizes average trial duration;
- 23 - Net Dwell Time (NDT) (s): is the sum of the duration of all fixations and saccades in the AOI,
24 across all subjects, divided by the number of subjects.

25 For the robustness tests, the following eye-tracking parameters have been extracted and analysed:

- 26 - Fixation Count: number (n) of fixations of all subjects divided by the number of subjects;
- 27 - Average Fixation Duration (s): the total duration of all fixations divided by the number of
28 fixations inside the AOI, across all subjects, divided by the number of subjects.

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32 Descriptive statistics with mean and standard deviations are used to report the distribution of
33 continuous parametric variables. A one-way analysis of variance (ANOVA) is performed to assess
34 the distribution of eye-tracking values with respect to color, with eye-tracking parameters as
35 dependent variables and color as an independent one. Chi-square test of independence is performed
36 to examine the relation between subjects' perception of financial attractiveness and color.
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40 **4. Results**

41 *4.1. Color, attention distribution and perceived attractiveness of the products*

42 Mean Entry Time values computed on the whole sample, i.e., the average scan path, reveal that
43 subjects tend to visually explore the stimulus in the following sequence: Objectives, RRP, Costs and
44 charges, Past performance. This sequence is the same irrespective of color.
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Conversely, color affects the attention dedicated to the reading of the KIIDs. The overall time needed for information screening is higher when the color is red than when it is blue, as revealed by the End Trial Time variable ($M_{\text{red}} = 43.06$, $SD = 13.67$; $M_{\text{blue}} = 39.39$, $SD = 14.16$; $F(1, 862) = 11.869$, $p = 0.0006$).

The added value of the eye-tracking is the increased detail of analysis thanks to the quantification of the attention distribution over the different sources of information. The analysis of the NDT highlights that color affects individuals' attention towards the RRP area, with red attracting more attention than blue ($M_{\text{red}} = 9.02$, $SD = 6.18$; $M_{\text{blue}} = 7.49$, $SD = 5.71$, $F(1, 862) = 11.322$, $p = 0.0008$). Moreover, a considerable effect on attention is also observed for the section *Past performance* ($M_{\text{red}} = 9.44$, $SD = 7.07$; $M_{\text{blue}} = 7.78$, $SD = 6.26$, $F(1, 862) = 10.625$, $p = 0.0012$), and especially for the section *Years of the crisis* ($M_{\text{red}} = 1.97$, $SD = 2.1$; $M_{\text{blue}} = 1.49$, $SD = 1.73$, $F(1, 862) = 10.676$, $p = 0.0011$), with red driving individuals to process information for a longer time than blue. Interestingly, the color plays a role in attracting individuals' attention also for the minor AOI of the *Disclaimer* ($M_{\text{red}} = 1.7$, $SD = 2.06$; $M_{\text{blue}} = 1.3$, $SD = 1.66$, $F(1, 862) = 7.899$, $p = 0.0051$). The presence of color just affects attention to the colored information, without impacting on attention dedicated to other sources of information – that are in black and white - as the quarter of the document related to the *Objectives* and the *Costs and charges*.

We perform robustness checks to ensure these results are not provided by only one eye-tracking outcome variable. Results are confirmed when considering as eye-tracking outcome variables the Fixation Count and the Average Fixation Duration, as revealed by Tables 1 and 2, respectively.

< Insert Tables 1 and 2 about here >

In a following step, we analyse the relationship between color and subjects' perception of financial attractiveness, with respect to KIIDs displaying either high, medium or low RRP scores, using a chi-square test of independence. For high RRP scores, the relation between color and subjects' perception of financial attractiveness is statistically significant, ($\chi^2(2, 288) = 40.52$, $p < .0001$); subjects are more likely to rate the product as highly attractive when the stimulus is blue. As charted in Figure 3, when the RRP of KIIDs is high, the blue color is associated with a higher proportion of products rated as highly financially attractive (41%) than red color (15%). Interestingly and symmetrically, red color

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3 is associated with a significantly higher proportion of products rated as poorly attractive (59%) than
4 blue color (24%).

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10 As displayed in Figure 4, this influence of color on products' attractiveness is observed also for KIIDs
11 with low RRP scores. The proportion of products rated as highly attractive when the color is blue is
12 41% against the 25% observed for the red color. At the same time, the proportion of products
13 perceived as poorly attractive when the color is red is 37%, against the 17% reported for the blue
14 color ($X^2(2, 288) = 18.294, p = .0001$).

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26 5. Discussion

27 This research attempts to investigate the influence of the two most used colors in marketing practice
28 – blue and red (Su *et al.*, 2019) – on the process of visual attention allocation and the subsequent
29 phase of attractiveness evaluation of a European and standardized document which describes
30 financial products: the KIID. In doing so, we adopt an interdisciplinary vision, which bridges
31 neuroscience and finance, in order to overcome the limitations of the traditional methods such as
32 questionnaire, focus group, and interview, which are not able to convey unbiased information about
33 the processes underlying the attentional mechanisms, that occur below the awareness level. On the
34 contrary, the eye-tracking allows to study the influence of stimuli features, i.e., the color, on the
35 decision-making process and, in particular, on the visual exploration phase, through reliable
36 estimation of the attentional allocation function.
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44 Results reveal that color affects the attention distribution pattern across the KIID, influencing, in turn,
45 the perception of product financial attractiveness. Eye-tracking data shows that the red, compared to
46 the blue, is associated with higher attention for the following sources of information: the graph of the
47 *Past performance*, especially the *Years of the crisis*, the *RRP*, and the *Disclaimer*. Conversely, no
48 differences in attention have been found for those sources of information – *Objectives* and *Costs and*
49 *Charges* - conveyed in black and white, even if blue or red are present in other parts of the stimulus.
50 Interestingly, besides impacting attention allocation, color is found to influence subjects' behavior:
51 results suggest that *red* pushes investors to rate the products as less financially attractive, especially
52 when the product RPP is high.
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5 The findings of the present research advance our knowledge in several ways. From a theoretical point
6 of view, this research contributes to extend the literature of color influence on financial decision-
7 making. Color research plays a pivotal role in improving marketing activities since color has been
8 found to impact consumers' impressions, perceptions, attitudes, and behaviors. Despite the
9 abundance of studies in this area, there is a paucity of research that tries to unveil color influence on
10 financial consumers' decision making. The paper by Song, Luximon, and Luo (2020) focuses on
11 financial advertising and suggests that a warm color could strengthen the perceived trustworthiness
12 in the financial ad. The present experimental study contributes to color research in the bank marketing
13 strand of the literature, clarifying that the specific context in which the subjects are embedded affects
14 the impact of color on behavior. With respect to previous literature, the study contributes to unveiling
15 the visual attentional mechanisms underlying the impact of red and blue colors on emotional
16 reactions, even when the visual information is not supposed to elicit an emotional involvement, as
17 that conveyed by the financial disclosure documents. Therefore, from a managerial point of view, our
18 results provide new insights for the financial and banking industries that, as long as they do not have
19 to comply with specific regulatory rules, will freely modulate specific features of the documents to
20 interact with their customers. Being a prominent visual element, color plays a crucial role in the
21 design of information documents regarding financial products since, even in the presence of the same
22 content, it is able to grab consumers' attention. Previous studies have largely shown that color
23 research is crucial for marketing managers who focus on visual design features of the brand, and
24 especially those involved in the choice of the color theme for brand logo design and redesign
25 (Bottomley and Doyle, 2006). Anyway, when dealing with financial information, investors are
26 thought to be more rational than general consumers' and therefore less sensitive to stimuli that are
27 not strictly relevant to solve the financial problem. According to traditional financial theories,
28 investors should not be affected by the visual representation of financial data, and thus color should
29 represent an irrelevant factor. On the contrary, neurofinance is showing that investors and financial
30 consumers might be affected by atmospheric and contextual elements also when dealing with
31 financial data (Bazley *et al.*, 2019; Ceravolo *et al.*, 2019) through unconscious and automatic
32 processes which are difficult to capture with standard approaches (Camerer *et al.*, 2005). Therefore,
33 if new knowledge is available about those processes and their impact on consumers' behaviors,
34 marketing managers who operate in the banking and financial sectors, might benefit from improving
35 brand perceptions, users' experience when surfing websites, disclosure communication, and
36 advertising.

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3 From regulators and policy-makers' point of view, our study informs about the importance of
4 considering the color of disclosure documents as an element able to influence behavior. Thus, we
5 suggest the need to study layout features when designing the products through neuroscientific
6 approaches, which overcome the limitation of traditional behavioral techniques. To this aim, we
7 endorse the use of the eye-tracking method in the authority toolkit when studying disclosure
8 documents.
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15 However, we should sound a word of caution in interpreting results since our findings do not suggest
16 that blue is always the best option in order to indicate secure financial products or red is always the
17 best option in order to indicate risky financial products. Our results only show that financial
18 documents in red grab the visual attention of investors to a greater extent than documents that adopt
19 the color blue, i.e., the red color drives a greater spontaneous visual focus to information sources. In
20 light of other empirical research (Bazley *et al.*, 2019), a possible interpretation of this result is that
21 the higher attention associated to red is driven by a higher risk perception, as corroborated by the
22 behavioral results on attractiveness perception. Moreover, since products underlying KIIDs cannot
23 be defined *ex-ante* as good or bad, results cannot lead to the assertion that color improves or worsen
24 the financial decision.
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32 The study has some limitations. Firstly, we only consider two colors; even if red and blue have been
33 proved to be the most important in affecting behavior, other studies have shown that other colors are
34 relevant for consumers' decision making. Thus, investigating the influence of all colors would have
35 greatly increased the number of variables and likely affected the interpretation of data. Secondly, the
36 experimental task consists of rating products' attractiveness, but subjects do not actually buy any
37 product. Previous studies have largely demonstrated how the task and the use of either own and real
38 resources influence the decision-making process (Ariely and Berns, 2010; Ayaz *et al.*, 2013; Raggetti
39 *et al.*, 2017). Thirdly, we do not distinguish for subjects' different levels of financial education,
40 statistical ability, and risk aversion. Therefore, different samples of participants should be analyzed
41 to study the influence of other variables and generalize the results. Learning effects associated to the
42 within-subjects experimental procedure could also affect subjects' attention and declared
43 attractiveness of financial products.
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54 Further developments of the study could investigate the influence of the background color, rather
55 than the color of specific sources of information. At the same time, it would be interesting a broader
56 investigation that involves more colors to study the influence of other warm (yellow, orange) and
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cool (purple) colors on attention distribution, as well as the role played by the green color, which is particularly relevant in finance to signal positive performance. Other studies can test whether the effects of colors on attention and behavior are different in other cultural settings, e.g., China, where red is not used to visualize financial losses or investigate how colorblind subjects behave when processing colored financial disclosure documents. Finally, advancing the present experimental protocol, a further study can be conducted within the visual heuristic theoretical framework (Chan and Park, 2015) to detect the influence on investment decisions of colors applied to visual images/graphs vs. written information.

References

- Ariely, D., and Berns G.S., (2010), "Neuromarketing: the hope and hype of neuroimaging in business", *Nature Reviews of Neuroscience*, Vol. 11, pp. 284–292.
- Aslam, M. M. (2006), "Are You Selling the Right Colour? A Cross-cultural Review of Colour as a Marketing Cue", *Journal of Marketing Communications*, Vol. 12 No. 1, pp. 15–30.
- Ayaz, H., Onaral, B., Izzetoglu, K., Shewokis, P.A., McKendrick, R., and Parasuraman, R., (2013), "Continuous monitoring of brain dynamics with functional near infrared spectroscopy as a tool for neuroergonomic research: empirical examples and a technological development", *Frontiers in Human Neuroscience*, 7:871. doi: 10.3389/fnhum.2013.00871
- Bagchi, R., and Cheema, A., (2013), "The Effect of Red Background Color on Willingness-to-Pay: The Moderating Role of Selling", *Journal of Consumer Research*, Vol. 39 No. 5, pp. 947-960.
- Bazley, W.J., Cronqvist, H., and Mormann, M.M., (2019), "Visual Finance: The Pervasive Effects of Red on Investor Behavior", *Swedish House of Finance Research Paper*, No 17-16.
- Bellizzi, J.A., Crowley, A.E., and Hasty R.W., (1983), "The effects of color in store design", *Journal of Retailing*, Vol. 59 No. 1, pp. 21–45.
- Bottomley, P.A., and Doyle, J.R., (2006), "The interactive effects of colors and products on perceptions of brand logo appropriateness", *Marketing Theory*, Vol. 6 No. 1, pp. 63–83.
- Camerer, C., Loewenstein, G., and Prelec, D., (2005), "Neuroeconomics: How Neuroscience. Can Inform Economics", *Journal of Economic Literature*, Vol. 63, pp. 9–64.
- Ceravolo, M., Farina, V., Fattobene, L., Leonelli, L. and Raggetti, G. (2019), "Presentational format and financial consumers' behaviour: an eye-tracking study", *International Journal of Bank Marketing*, Vol. 37 No. 3, pp. 821-837
- Chan, C.S.R., and Park, H.P., (2015), "How images and color in business plans influence venture investment screening decisions", *Journal of Business Venturing*, Vol. 30, Issue 5, pp. 732-748.

- 1
2
3 Changizi, M.A., Zhang, Q., and Shimojo, S., (2006), "Bare skin, blood and the evolution of primate
4 color vision", *Biology Letters*, Vol. 2 No. 2, pp. 217–221.
5
6
7 Chaouali, W., Lunardo, R., Yahia, I.B., Cyr, D., and Triki, A. (2019a), "Design aesthetics as drivers
8 of value in mobile banking: does customer happiness matter?", *International Journal of Bank*
9 *Marketing*, www.emeraldinsight.com/0265-2323.htm.
10
11 Chaouali, W., Yahia, I.B., Lunardo, R., and Triki, A. (2019b), "Reconsidering the "what is beautiful
12 is good" effect - When and how design aesthetics affect intentions towards mobile banking
13 applications", *International Journal of Bank Marketing*, www.emeraldinsight.com/0265-2323.htm .
14
15
16 Chaudhuri, A., and Holbrook, M.B., (2001), "The chain of effects from brand trust and brand affect
17 to brand performance: The role of brand loyalty", *Journal of Marketing*, Vol. 65 No. 2, pp. 81–93.
18 doi:10.1509/jmkg.65.2.81.18255.
19
20
21 Crowley, A.E., (1993), "The two-dimensional impact of color on shopping", *Marketing Letters*, Vol.
22 4, pp. 59–69.
23
24 Davenport, J.L., (2007), "Consistency effects between objects in scenes", *Memory & Cognition*, Vol.
25 35 No. 3, pp. 393-401.
26
27 Delgado-Ballester, E., and Luis Munuera-Alemán, J., (2005), "Does brand trust matter to brand
28 equity?", *Journal of Product & Brand Management*, Vol. 14 No. 3, pp. 187–196. doi:10.1108/
29 10610420510601058.
30
31
32 Djasasbi, S., Siegel, M., and Tullis, T., (2010), "Generation Y, web design, and eye tracking",
33 *International Journal of Human-Computer Studies*, Vol. 68 No. 5, pp. 307–323.
34
35
36 Elliot, A. J., and Aarts, H., (2011), "Perception of the color red enhances the force and velocity of
37 motor output", *Emotion*, Vol. 11, pp. 445–449.
38
39 Elliot, A.J., and Maier, M.A., (2012), "Color-in-context theory", *Advances in Experimental Social*
40 *Psychology*, Vol. 45, pp. 61–125.
41
42 Elliot, A.J., Maier, M.A., Binser, M.J., Friedman, R., and Pekrun, R., (2009), "The effect of red on
43 avoidance behaviour in achievement contexts", *Personality and Social Psychology Bulletin*, Vol. 35
44 No. 3, pp. 365–375.
45
46
47 Fortier-Gauthier, U., Dell'acqua, R., and Jolicœur, P. (2013), "The "red-alert" effect in visual search:
48 evidence from human electrophysiology", *Psychophysiology*, Vol. 50 No. 7, pp. 671-679.
49
50
51 Fraser, T., and Banks, A., (2004), *Designer's color manual: The complete guide to color theory and*
52 *application*, San Francisco: Chronicle Books.
53
54 Gegenfurtner, K. R., and Rieger, J. (2000), "Sensory and cognitive contributions of color to the
55 recognition of natural scenes", *Current Biology*, Vol. 10 No. 13, pp. 805–808.
56
57
58 Gorn, G. J., Chattopadhyay, A., Sengupta, J., and Tripathi, S. (2004), "Waiting for the web: how
59 screen color affects time perception", *Journal of Marketing Research*, Vol. 41 No. 2, pp. 215–225.
60

- 1
2
3 Hagtvedt, H., and Brasel, A. S. (2017), "Color saturation increases perceived product size", *Journal*
4 *of Consumer Research*, Vol. 44 No. 2, pp. 396–413.
5
6 Hansen, T., and Gegenfurtner, K. R. (2009), "Independence of color and luminance edges in natural
7 scenes", *Visual Neuroscience*, Vol. 26 No. 1, pp. 35–49.
8
9
10 Holmqvist K., Nyström M., Andersson R., Dewhurst R., Jarodzka H., and Van de Weijer J., (2011),
11 *Eye-tracking: A Comprehensive Guide to Methods and Measures*, Oxford, U.K: Oxford University
12 Press.
13
14 Kliger, D., and Gilad, D., (2012), "Red light, green light: Color priming in financial decisions", *The*
15 *Journal of Socio-Economics*, Vol. 41 No. 5, pp. 738–745.
16
17
18 Labrecque, L.I., and Milne, G.R., (2011), "Exciting red and competent blue: the importance of color
19 in marketing", *Journal of the Academy of Marketing Science*, Vol. 40, pp. 711-727.
20
21
22 Labrecque, L.I., Patrick, V.M. and Milne, G.R., (2013), "The Marketers' Prismatic Palette: A Review
23 of Color Research and Future Directions", *Psychology and Marketing*, Vol. 30, pp. 187-202.
24
25
26 Lee, S., and Barnes Jr, J. H., (1989), "Using color preferences in magazine advertising", *Journal of*
27 *Advertising Research*, Vol. 29 No. 6, pp. 25–30.
28
29
30 Loureiro, S.M.C, and Sarmiento, E.M. (2017), "Enhancing brand equity through emotions and
31 experience: the banking sector", *International Journal of Bank Marketing*, Vol. 36 No. 5, pp. 868-
32 883.
33
34
35 Luna, B., Velanova, K. and Geier, C.F., (2008), "Development of eye-movement control", *Brain and*
36 *Cognition*, Vol. 68, pp. 293–308 <http://dx.doi.org/10.1016/j.bandc.2008.08.019>.
37
38
39 Mahnke, F.H., (1996), *Color, environment, and human response*, New York: Reinhold.
40
41
42 McMains, S. A., and Kastner, S. (2010), "Defining the units of competition: Influences of perceptual
43 organization on competitive interactions in human visual cortex", *Journal of Cognitive Neuroscience*,
44 Vol. 22 No. 11, pp. 2417–2426.
45
46
47 McMains, S.A., and Kastner, S., (2010), "Defining the units of competition: influences of perceptual
48 organization on competitive interactions in human visual cortex", *Journal of Cognitive Neuroscience*,
49 Vol. 22, pp. 2417–2426.
50
51
52 Mehta, R., and Zhu, R., (2009), "Red or blue? Exploring the effects of color on cognitive task
53 performances", *Science*, 323(5918):1226-9.
54
55
56 Moller, A. C., Elliot, A. J., and Maier, M. A. (2009), "Basic hue-meaning associations", *Emotion*,
57 Vol. 9, pp. 898–902.
58
59
60 Mouzas, S. (2016), "Performance based contracting in long-term supply relationships", *Industrial*
Marketing Management, Vol. 59 No. 3, pp. 50–62. doi:10.1016/j.indmarman.2016.05.028 .

- 1
2
3 Murray, D.C., and Deabler, H.L., (1957), "Colors and mood-tones", *Journal of Applied Psychology*,
4 Vol. 41 No. 5, pp. 179–283.
5
6 Payen, V., Elliot, A. J., Coombes, S. A., Chalabaev, A., Brisswalter, J., and Cury, F. (2011), "Viewing
7 red prior to a strength test inhibits motor output", *Neuroscience Letter*, Vol. 495, pp. 44–48.
8
9
10 Raggetti, GM., Ceravolo, M.G., Fattobene, L., and Di Dio, C., (2017), "Neural correlates of Direct
11 Access Trading in a Real Stock Market: An fMRI Investigation", *Frontiers in Neuroscience*, 11:536.
12 doi: 10.3389/fnins.2017.00536
13
14 Roschk, H., Loureiro, S. M. C., and Breitsohl, J., (2017), "Calibrating 30 Years of Experimental
15 Research: A Meta-Analysis of the Atmospheric Effects of Music, Scent, and Color", *Journal of*
16 *Retailing*, Vol. 93 No. 2, pp. 228-240.
17
18
19 Schaie K.W., (1961), "Scaling the associations between colors and mood tones", *American Journal*
20 *of Psychology*, Vol. 74, pp. 266–273.
21
22
23 Sharif, B., and Maletic, J.I., (2010), "An Eye Tracking Study on the Effects of Layout in
24 Understanding the Role of Design Patterns", *proceedings of the 26th IEEE International Conference*
25 *on Software Maintenance (ICSM 2010)*, Timisoara, Romania, Sept 12-18, pp. 1-10.
26
27
28 Singh S., (2006), *Impact of Color on Marketing*, University of Winnipeg: Canada.
29
30 Song, Y., Luximon, Y. and Luo, J., (2020), "A moderated mediation analysis of the effect of lettering
31 case and color temperature on trustworthiness perceptions and investment decisions", *International*
32 *Journal of Bank Marketing*, Vol. 38 No. 4, pp. 987-1005.
33
34
35 Soon, C.S., Brass, M., Heinze, H.-J. and Haynes, J.-D., (2008), "Unconscious determinants of free
36 decisions in the human brain", *Nature Neuroscience*, Vol. 11 No. 5, pp. 543–54
37
38 Su, L., Peng, Cui, A., and Walsh, M.F., (2019), "Trustworthy Blue or Untrustworthy Red: The
39 Influence of Colors on Trust", *Journal of Marketing Theory and Practice*, Vol. 27 No. 3, pp. 269-
40 281.
41
42
43 Vrechopoulos, A., and Atherinos, E., (2009), "Web banking layout effects on consumer behavioural
44 intentions", *International Journal of Bank Marketing*, Vol. 27 No. 7, pp. 524-546.
45
46 Wolfe J., (2000), *Visual attention*, In K. K. De Valois (Ed.), *Seeing* (2nd ed., pp. 335–386). San
47 Diego, CA: Academic Press.
48
49
50 Wright, A., (1988), *The beginner's guide to color psychology*, London: Color Affects Ltd.
51
52 Wright, J. M. (1972). "On the problem of selection in iconic memory", *Scandinavian Journal of*
53 *Psychology*, Vol. 13, pp. 159–171.
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Table 1. One-way ANOVA results with Fixation count (n) for each of the AOI as dependent variable and color as independent one

main AOIs	Color				p-value
	Red		Blue		
	M	SD	M	SD	
RRP	24.915	16.501	20.819	15.244	0.0008
Past performance	20.363	13.452	17.655	13.211	0.0081
Objectives	44.015	18.87	42.825	20.475	n.s.
Cost and charges	16.243	12.733	15.316	12.34	n.s.
minor AOIs					
Years of the crisis	4.36	4.22	3.491	3.727	0.0045
Disclaimer	4.652	5.703	3.558	4.535	0.0057
Last years	4.237	3.62	4.579	4.203	n.s.
Risk scale	2.14	1.696	2.164	1.694	n.s.

Table 2. One-way ANOVA results with Average Fixation Duration (ms) for each of the AOI as dependent variable and color as independent one

main AOIs	Color				p-value
	Red		Blue		
	M	SD	M	SD	
RRP	337.527	107.89	326.73	102.248	n.s.
Past performance	429.696	186.504	398.018	178.556	0.236
Objectives	356.817	93.639	359.081	101.051	n.s.
Cost and charges	325.437	108.781	347.34	126.512	0.155
minor AOIs					
Years of the crisis	337.736	273.246	281.122	231.568	0.0036
Disclaimer	261.783	227.187	220.252	218.842	0.152
Last years	512.343	366.205	480.724	370.132	n.s.
Risk scale	282.461	197.483	281.073	199.403	n.s.