The Magic of Colour:
How Palette Choice Affects the Initial Trust Towards News Web-Interfaces

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The Asian Conference on Psychology & the Behavioral Sciences 2024
Official Conference Proceedings

Abstract
In the realm of online user interaction with web interfaces, trust is paramount. Our research focused on the pivotal role of colour schemes within news web interfaces and their correlation with the propagation of misinformation in modern media. We explored the influence of colour schemes on users' initial trust levels, particularly focusing on monochromatic schemes, including a binary black-and-white scheme, and variations in colour saturation. Results revealed significant differences in trust ratings for various colour schemes ($p < .001$), with substantial effect size ($\eta^2 = 0.569$). Higher trust ratings were observed for the black-and-white (mean = 3.888), green (mean = 3.724), and grey (mean = 3.625) schemes. Conversely, red (mean = 2.895), yellow (mean = 3.124), and blue (mean = 3.188) schemes yielded lower ratings. Notably, interfaces with less saturated background colours were generally associated with increased trust ($p = .036$). Furthermore, we examined the role of pre-existing beliefs on interface trust. Interestingly, these beliefs only significantly affected trust assessments when interfaces received high ratings ($p = .001$), emphasizing the cognitive aspect of overall assessments. These results underscore the significance of colour as a perceptual attribute in news interfaces and its impact on initial user trust. Moreover, the study highlights the interplay between emotional perception, influenced by colour schemes, and cognitive aspects, represented by pre-existing beliefs, in shaping users' judgments of interface trustworthiness.

Keywords: Online Trust, Colour, Colour Perception, Web Interfaces, Human Digital Interaction, Fake News

Introduction

Let's imagine that you're meeting someone new for the first time. You haven't interacted with them before, nor have you heard anything about them — this person is a blank slate for you. However, in the first few seconds of interacting with them, you form some initial impressions. Whether this person seems normal or not, whether they pose a threat to you, whether you want to continue interacting with them, and whether you're willing to trust them.

In the digital environment, trust is one of the important factors for the success of interactions between information consumers and providers (Möhlmann and Geissinger, 2018). The sweeping premise of all our research is that the basic structure and trust factors typical of the physical environment are preserved in the digital one, although with a few peculiarities. The main one is this: when you interact with anyone in the digital realm, you don't do it directly: there's always an interface between you and the other party (Marcella, 1999), which is the external shell of the system that makes this remote interaction possible. Consequently, the inevitable question arises: how do you understand whether this interface, as a mediator or an independent party of trust, can be trusted? This is where interface cues and prompts come to the rescue, serving as trust triggers (Lumsden, MacKay, 2006).

Trust can be defined as a generalized expectation shared between two or more parties, reflecting one party's willingness to rely on another even amidst uncertainty, thus providing a sense of relative security (Kosova and Gorbunova, 2023a). Initial, or primary, trust is conceptualized as a type of trust formed in the initial encounter (Koufaris, Hampton-Sosa, 2004), and t is presumed to play the most significant role in the digital space, abundant with opportunities to quickly switch to alternative information providers.

The previous researched identified four main types of interface cues, or interface elements that can contribute to the attribution of trust towards it by the user (Kosova, Gorbunova, 2023a): social abilities cues, content cues, structural usability cues, and atmospheric design cues. The first type, social abilities cues aim at creating an illusion of human-to-human instead of human-to-system, or human-to-interface interaction in the digital world. This type of cues, including for instance the indication of presence on social networks or the ability to view and to post comments, has already proven its relevance for web-based news interfaces (Kosova, Gorbunova, 2023b). The second type, content cues, refers to informational components of the website, including both their internal (e.g., content itself) and external (e.g., content form, such as text or video, emotional or neutral style etc.) characteristics. The third type, structural usability cues, includes website elements intending to enhance the perceived simplicity and usefulness of the interface (e.g., navigation bar, pages layout etc.). Finally, atmospheric design cues are used to convey company values and brand associations through appearance aspects, including at the subconscious level. Among them, colour schemes stand out as it is almost impossible to imagine a totally uncoloured web-interface (especially if you don't forget that achromatic colours are still colours).

Another question is: why news interfaces? What is so different about them? There are two reasons explaining why we focused our research on news interfaces. From a pragmatic perspective, studying news interfaces is now more useful and relevant than ever: fake news is becoming increasingly prevalent, it is easier to create them in various modalities due to the explosive development of artificial intelligence, thus users are faced with the task of recognizing untrustworthy sources. From a scientific standpoint, studying news interfaces is interesting simply because, from the perspective of trust, they have been largely unexplored

until now (except for Kaczmarek-Gajewska and McDonnell, 2021, for instance). This is probably related to some peculiarities of news interfaces that distinguish them from more commonly studied web interfaces, such as commercial, banking, or medical ones. Firstly, users often come to a news interface with a preconceived belief either about the quality of the resource itself or about the type of information the site should convey to the audience. This immediately brings to mind the problem of confirmation bias: the user expects that a trusted news source will support their viewpoint on issues important to them. Secondly, in the case of news interfaces, the condition of risk, or vulnerability of the trustor, which is crucial for trust formation (Evans and Krueger, 2011) becomes significantly less noticeable and obvious compared to usually studied interfaces. For example, when a suspicious online store website asks the user to enter their credit card details, the user understands that they are risking their money. However, when a suspicious news website asks the user to share fake news, the risk is more hidden and less well understood. Therefore, within the framework of our research, we set ourselves the separate task of highlighting the condition of risk for the user within the research paradigm to more reliably isolate the phenomenon of trust itself, rather than associated phenomena.

So, we have covered the specifics of news interfaces and conceptualized trust, leaving only colour to discuss. At its core, colour comprises light wavelengths interpreted by the brain into the spectrum of colours perceived by the human eye (Singh, 2006). From a psychological perspective, colour is a complex stimulus that goes beyond visual perception, interacting deeply with emotions, cognitive processes, and behavior, profoundly shaping human experience.

When we deconstruct colour into its constituents, we can distinguish three primary dimensions: hue, saturation, and brightness. Among them, hue determines the category of pure colours to which a specific stimulus belongs (e.g., red, blue, or green). Saturation describes the intensity of colour: is it more or less colourful? Chromatic colours (such as red, purple, orange, etc.) are less saturated than achromatic colours (such as grey or white). Brightness, or lightness, depicts the abundance of light in the colour: how much black or white is mixed in it.

To date, most colour-trust researched has focused on how trust is influenced by hue. Colour hue, viewed as a spectrum of hues, presents a complex array of shades, often categorized into discrete indicators like purple, blue, green, yellow, orange, and red. However, comprehensive studies covering the entire spectrum are rare due to the complexity of data collection and analysis. Among them, Bonnardel et al. (2011) investigated website appeal, evaluating 23 hues and finding blue and orange most preferred by ordinary users, with professional designers additionally favoring gray. Bottomley and Doyle (2006) linked various hues appropriateness to trust formation, noting congruence between product type and colour. Ha (2009) studied five hues (red, yellow, green, blue, purple) and associated blue and green with most successful trust for banking websites. Research often categorizes colour hues into warm and cool, with cool colours like blue consistently associated with higher trust levels compared to warm colours like red and yellow (Kim and Moon, 1998; Su et al., 2019; Coursaris and Swierenga, 2010). However, studies show cultural variations and complexities, such as preferences for warm colours in certain contexts (Hawlitschek et al., 2019; Khuong et al., 2018). Further research is needed to understand these nuances beyond simplistic warm-cold distinctions.

The effect of colour saturation on trust is significantly less frequently studied. Papachristos et al. (2005, 2006) developed a model linking colour to trust through machine learning techniques, identifying variables like hue, brightness, and saturation. Notably, the saturation of secondary colour influenced perceived site value even more than its hue. Pelet et al. (2009, 2011, 2013) found that low-saturated colours correlate positively with trust, competence, and professionalism, while highly saturated colours can be perceived as aggressive, negatively affecting trust. Skulmowski et al. (2016) and Pichierri and Pino (2023) support these findings, showing the negative impact of high saturation on website perception and consumer trust in green marketing, respectively.

Previous research has also established that users' pre-existing beliefs about the quality of a news interface or source can significantly influence trust. For instance, Ecker et al. (2014) found that users' prior racial beliefs influence their perception of news regarding a robbery whether committed or prevented by an Australian Aboriginal person. Čavojová et al. (2024) examined several predictors of trust in COVID-19 fake news and similarly concluded on the significant impact of consistent prior beliefs on trust and the desire to share news. Finally, Kosova and Gorbunova (2023b) demonstrated that pre-existing beliefs about a site's tendency to publish true or fake news are among the most significant additional factors influencing trust in interfaces containing social cues. However, in the context of evaluating news interfaces specifically, rather than the content itself, the impact of prior beliefs on the perception of the news source remains an underexplored issue.

Thus, we formulate the following hypotheses:

H1. Interface colour significantly influences the level of trust in a news web interface.
H1.1. Among all monochromatic schemes, schemes with cool hues (blue, purple, green) will receive the highest ratings on the trust scale.
H2. The saturation of the interface background colour significantly influences the level of trust in a news web interface.
H2.1. Among all monochromatic schemes, interfaces with less saturated dominant colours will receive higher ratings.
H3. Pre-existing beliefs will have a statistically significant impact on the evaluation of interfaces.

Methodology

Participants

The online study involved 119 participants (69 female, mean age 27.87, StD = 5.67). All respondents were native Russian speakers, had normal or corrected-to-normal vision, were not colour blind, and did not have psychological disorders. Participants were recruited through social networks and the Yandex.Toloka service. 37 respondents reported being in the process of obtaining higher education, 35 respondents reported having at least one completed higher education, 30 respondents had vocational education, and an additional 17 respondents reported having no higher education.

Materials

The study was conducted online using a specially designed website, where questionnaires and stimulus materials were presented. The stimuli consisted of 48 screenshots of news interfaces

structured as follows: there were 3 basic designs, varying in interface hue and saturation of the dominant and secondary colours (if the dominant colour was less saturated, the secondary colour was more saturated, and vice versa). Eight colour schemes were considered: one dichromatic black-and-white and seven monochromatic (gray, red, orange, yellow, green, blue, purple). Images were created using Figma, with the "saturated" condition implying 100% colour saturation and the "unsaturated" condition implying 25% colour saturation. This ensured perceptible differences between them, making both colours clearly visible and easily recognizable by respondents.

For clarity in subsequent text, by "saturated" condition, we understand interfaces where the dominant colour was saturated and the secondary colour was unsaturated (in the case of the black-and-white scheme: the dominant colour was black, the secondary colour was white). By "unsaturated" condition, we mean interfaces where the dominant colour was unsaturated and the secondary colour was saturated (in the case of the black-and-white scheme: the dominant colour was white, the secondary colour was black).

To add realism to the stimulus material, we also used specially written fake news in the interfaces, covering neutral topics that did not elicit strong emotional reactions (primarily science and culture; excluding politics, religion, etc.). The news underwent preliminary verification for credibility through a survey of 10 respondents (5 were informed they were evaluating fake news, 5 were naïve) using two questions, each rated on a 5-point Likert scale:

- Could this have happened in reality?
- Do you believe this really occurred?

Only news items that scored an average rating above 2 for each question and a combined total of 5 across both questions were included as stimuli. Examples of the final stimuli with news in Russian are provided in Figure 1.

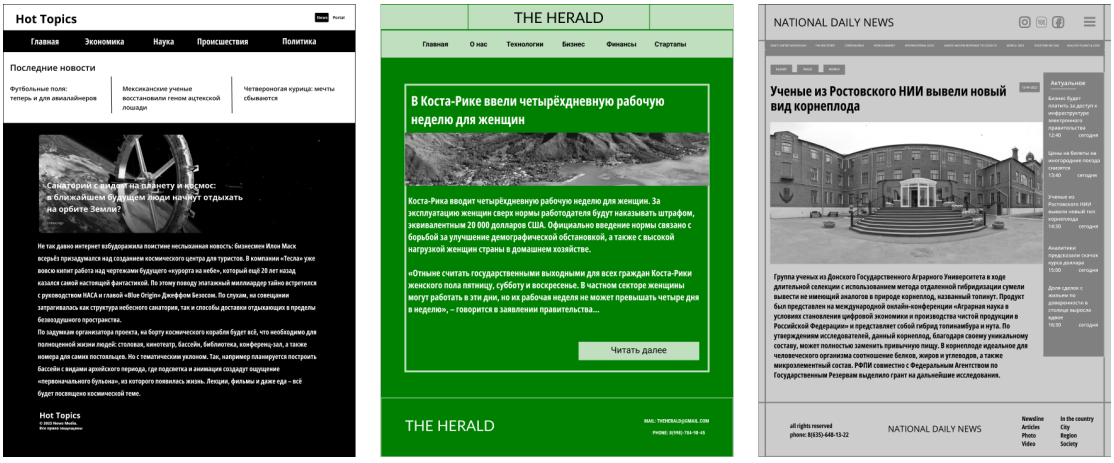

Figure 1: Examples of stimuli (saturated black and white, saturated green, unsaturated grey).

Procedure

Prior to the experiment, all respondents provided informed consent to participate in the study and for the processing and analysis of their data. Subsequently, all respondents completed a demographic questionnaire (questions about gender, age, education level) and a behavioral questionnaire (frequency of reading news online, frequency of following links to the original news source, frequency of double-checking news information, and the model of information source selection online: reading only from a fixed list of trusted sources, having no fixed list

but reading only from sources with a good reputation, reading only from sources recommended by trusted individuals, or reading everything that comes into their information field).

Next, respondents were randomly assigned to three groups of prior belief: G1 (N = 45) received an instruction disclaimer stating that all news in the experiment were fake, G2 (N = 35) received a disclaimer stating that all news in the experiment were true, and G3 (N = 39) served as the control group and received no disclaimer. At the end of the experiment, respondents were asked if they received any disclaimer and which one, to ensure that the condition was understood. Only respondents who accurately characterized their group based on the disclaimer were included in the final sample.

Except for the disclaimer, the instructions for the different experimental groups were identical. Respondents were asked to imagine themselves as managing editors of a news aggregator (a popular media format in Russia that collects news from various sources and publishes them on one platform); their task was to select trusted sources for publication on their media platform. We specifically formulated and highlighted two risk conditions: hypothetical (if you select sources "poorly," your media outlet will lose readers and money) and real (if you select sources "poorly," you will not be able to participate in a small financial reward lottery). After reading the instructions, participants proceeded to the main part of the experiment, during which they were presented with 48 stimuli, as described in the Materials section, where for each stimulus participants answered two questions: rate how much they trusted the source (on a 6-point Likert scale) and decide whether they wanted to choose that source for their news aggregator (yes or no). A schematic representation of the procedure is presented in Figure 2.

Figure 2: Experiment procedure

Results

First and foremost, we examined whether the colour of the interface has a statistically significant impact on trust towards it. To do this, we checked the normality of data distribution in colour groups using the Shapiro-Wilk test (we will conduct it for selecting the analysis method for each variable). Subsequently, since the distribution in some groups was non-normal, we tested the null hypothesis of no influence of colour scheme on trust ratings using the Kruskal-Wallis test. The obtained results ($p < 0.001$, $H = 67.11$, $\eta^2 = 0.57$) indicate that the colour scheme significantly influences the level of trust, with a considerable effect

size. The top three leaders in terms of trust levels among the colour schemes are the sole dichromatic black-and-white, as well as the monochromatic green and gray. More detailed descriptive statistics for each colour scheme are provided in Table 1.

Colour scheme	**Mean trust**	**StD**	**25%**	**50%**	**75%**	**P-value for saturated vs. unsaturated version**
Black & white	3.89	1.15	3.17	4.00	4.67	< 0.001
Green	3.72	1.20	3.00	3.83	4.67	0.01
Grey	3.62	1.18	2.83	3.83	4.50	0.07
Orange	3.48	1.08	2.83	3.50	4.25	< 0.001
Purple	3.48	1.22	2.58	3.50	4.42	0.07
Blue	3.19	1.13	2.42	3.00	4.00	< 0.001
Yellow	3.12	1.19	2.33	3.17	4.00	< 0.001
Red	2.89	1.22	1.92	2.83	3.83	< 0.001

Table 1. Trust scores for colour schemes

Next, we categorized the colours into three groups: cool colours (blue, purple, green; mean trust for group = 3.46, StD = 1.60), warm colours (orange, yellow, red; mean trust for group = 3.17, StD = 1.61), and neutral, or achromatic, colours (black-and-white and gray; mean trust for group = 3.62, StD = 1.57) — and compared their results using the Kruskal-Wallis test. The obtained results ($p < 0.001$, $H = 60.77$, $\eta^2 = 0.01$) indicate a statistically significant difference between the groups, although the effect size is quite small.

Next, we analyzed the impact of saturation on trust. It is important to note that since the stimuli were monochromatic, the saturation of the dominant and secondary colours varied simultaneously and had an inverse relationship: if the dominant colour was saturated, the accent colour was not, and vice versa. Since in this case the data in both groups had a normal distribution, we conducted a paired t-test, which showed a statistically significant difference between the groups ($p = 0.04$), with a moderate effect size (Cohen's $d = 0.29$). It should be noted that the statistical significance of saturation remains even when excluding the black-and-white colour scheme ($p = 0.03$, $d = 0.30$). Descriptive statistics for the groups considering the black-and-white scheme are presented in Table 2.

Dominant colour saturation	**Mean trust**	**StD**	**25%**	**50%**	**75%**
Saturated	3.29	0.96	2.75	3.17	3.89
Unsaturated	3.56	0.96	2.98	3.58	4.08

Table 2. Trust scores for dominant colour saturation levels

Using the Wilcoxon test, we also compared the saturated and desaturated conditions for each colour scheme. The obtained results (presented in Table 1) indicate that the difference between these conditions is statistically significant for all colour schemes except for gray and purple.

Finally, we examined the impact of pre-existing belief on the evaluation of interface trustworthiness using one-way ANOVA. The results showed no statistically significant effect ($p = 0.18$, $F = 1.72$). Descriptive statistics for the groups are provided in Table 3.

Dominant colour saturation	**Mean trust**	**StD**	**25%**	**50%**	**75%**
G1: all news is fake	3.29	0.96	2.65	3.25	3.70
G2: all news is true	3.67	0.95	3.25	3.60	4.24
G3: control group	3.36	0.86	2.76	3.20	3.99

Table 3. Trust scores for prior judgment groups (all colours)

Considering the results of previous studies (Kosova and Gorbunova, 2023b), where a statistically significant impact of pre-existing belief was observed only for the group of interfaces perceived as more trustworthy (interfaces containing a social cue), we isolated the top three trustworthy colour schemes (black and white, green, and gray) and separately tested for the presence of the pre-existing belief effect using one-way ANOVA. In this scenario, a statistically significant difference was indeed found ($p = 0.001$, $F = 6.87$), although the effect size remained negligible ($d < 0.001$). Additionally, we conducted pairwise comparisons between the groups using unpaired t-tests (this increases the risk of Type I error with multiple comparisons, however, in this case, we were interested in the relationships between individual groups). The results showed a statistically significant difference between G1 and G2 ($p = 0.001$), as well as between G2 and G3 ($p = 0.001$), which indirectly suggests that among the declared forms of pre-existing belief, it is the positive belief (the site publishes truthful news) that primarily influences trust.

Discussion

The first point of note lies in the analysis of individual colour schemes, where the leading positions are taken by the achromatic neutral black-and-white, cool green, and neutral gray. Interestingly, the blue scheme, conversely, finds itself among the outsiders, despite the discussion in the Introduction section of the study, which predominantly concludes that blue is the most trustworthy colour (it is worth noting though that the bulk of such studies compare blue with red — and here, as in previous literature, blue still surpasses red in terms of trustworthiness). We attribute these results to two potential explanations. Firstly, it is important to consider the specific design where monochromatic interfaces were tested, which are rare in themselves and may trigger distrust due to their unfamiliarity, leading to anomalous results. Secondly, in response to the open-ended question “What do you pay attention to when deciding whether to trust a news source?” users consistently emphasize the neutrality of the source — and in this sense, achromatic black-and-white and gray schemes stand out, which some researchers associate with the absence of strongly expressed emotional connotations, unlike chromatic colours (Jue and Kwon, 2013).

The saturation of the dominant colour also exerts a significant influence on the level of trust (and this thesis holds true both when considering the black-and-white scheme, for which a strict definition of saturation or desaturation of the dominant colour is not entirely accurate,

and without its consideration). Overall, the results aligned with our expectations: interfaces with less saturated dominant colours received higher ratings on the trust scale. Such results can be explained by the fact that vibrant and saturated colours are perceived as more emotionally charged, promotional, and sometimes even more aggressive, while less saturated colours are associated with competence and professionalism (Pelet and colleagues, 2013).

The influence of pre-existing belief remains an interesting topic for further research. The effect of pre-existing belief itself is likely associated with a phenomenon known as confirmation bias (Nickerson, 1998; Cook et al., 2015). Our results indicate that this factor may have secondary significance in assessing the trustworthiness of the interface: a statistically significant effect is observed only for interfaces that do not elicit user affective rejection of the colour scheme. Interestingly, statistically significant differences in pairwise comparisons are only found when comparing with G2, which received the pre-existing belief that all news is truthful. This can be interpreted as follows: a trustworthy colour scheme contributes to a statistically significant increase in the level of trust in any case; moreover, if the user is already willing to trust the interface, their level of trust in the trustworthy colour scheme will be significantly higher than that of other user groups. Indirectly, this may indicate: a) the primacy of the affective component, as the influence of the colour scheme is evident regardless of cognitive pre-existing belief; b) the potential significance of the confirmation bias phenomenon in evaluating quality news interfaces: the user's readiness to trust the site is significantly reinforced by the trustworthy digital scheme.

Conclusion

In the context of online user interaction with web interfaces, trust emerges as a critical factor. Our investigation underscores the critical role of monochromatic colour schemes in shaping users' initial trust levels within news web interfaces. Neutral black-and-white, cool green, and neutral gray schemes emerged as top performers, challenging conventional beliefs about the trustworthiness of blue colour. The saturation level of the dominant colour also significantly influenced trust, with less saturated dominant colours generally receiving higher ratings. Moreover, while pre-existing beliefs exerted a secondary influence, they significantly impacted trust assessments only in the absence of colour-induced aversion. These findings illuminate the complex interplay between emotional perception, cognitive biases, and colour psychology in determining interface trustworthiness, offering valuable insights for enhancing credibility and combatting misinformation in digital media environments.

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