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# Colour Naming: a Multilingual and Multicultural Study

Antti RAIKE, Harald ARNKIL, Timo HONKELA, Jyrki MESSO
Aalto University

## ABSTRACT

It is generally accepted that there are cross-linguistic universal tendencies in the naming of colours. This is due in large part to the findings of Berlin and Kay. Recently, however, these universalist findings have been challenged, on both methodological and substantive grounds. Nisbett's research on cultural cognition offers another interesting theory and provides a theoretical framework for our cross-cultural study. Through observation of how people from diverse cultures view images, Nisbett has defined two different cognitive styles: holistic and analytic. He combines cultural and cognitive perspectives that enrich the understanding of cultural influence in web usability research, thus creating a new approach in this field. Research in the field of online communication has previously focused on the consistency of the cognitive styles of people within the same cultural context. In this paper we report results of an experiment in which participants (N=67), representing 15 different languages as mother tongues, name the colours of the same photograph. An eye-tracking device was used in the experiment to record eye fixation and saccades. This information with the colour namings was analysed using the self-organizing map algorithm.

## 1. INTRODUCTION

Web accessibility and usability are communication issues that expand on art, language, cognition, and emotion. Colours may give instinctive emotional responses that shape the user experience. Berlin and Kay (1969) found universal patterns in colour naming data collected from several languages. These findings were later challenged on both methodological and substantive grounds. From these starting points The World Color Survey (2002) has continued the research by collecting and statistically testing comprehensive colour naming data from 110 unwritten languages from non-industrialized societies.

Research on online communication has focused on the consistency of the cognitive styles of people within the same cultural context. Nisbett (2001, 2002) with Masuda and Nisbett (2001) provide a theoretical framework for the cross-cultural study defining a holistic and analytic cognitive style by revealing perceptual differences between East Asians and Westerners. Nisbett combines cultural and cognitive perspectives that enrich the understanding of cultural influence in web usability. The holistic and analytic styles of viewing echo phenomenologist Merleau-Ponty's (2004) concepts of *living perception* and *reflective attitude*.

Cognitive style is a preferred approach to organise information, and eye movements can provide a window into a person's thinking patterns (Dong & Lee, 2008; Namatame & al., 2006). The anthropological and psychological studies of general cognitive processes suggest that cognitive styles are connected to culture (Dong & Lee, 2008; Nisbett & al., 2001). The purpose of our study was to test these hypotheses and to use the results for proposing approaches for enhancing the accessibility of web page design.

## 2. METHOD

We made an experiment along another larger design experiment to see how participants (N=67) representing 15 different languages as mother tongues would A) indicate colours in a previously unseen photograph during an instructed information seeking task, and B) name the five most important colours of the same photograph. In our study, we seek to establish: 1) if holistic and analytic people show different viewing patterns, 2) if there is any correlation with eye-tracking data and the naming order of colours.

Holistic and analytic reasoning can be summarized as follows: Holistic thought involves 1) orientation to the context or field as a whole, including attention to the relationships between a focal object and the field; 2) a preference for explaining/predicting events on the basis of such relationships; 3) an approach that relies on experience-based knowledge rather than abstract logic and the dialectical; 4) an emphasis on change, recognition of contradiction, and the need for multiple perspectives. Analytic thought includes 1) a detachment of the object from its context; 2) a tendency to focus on the attributes of the object in order to assign it to categories; 3) a preference for using rules about categories to explain and predict an object's behavior; 4) inferences that rest in part on the decontextualization of structure from content, use of formal logic, and avoidance of contradiction. (Nisbett & al., 2001).

A Tobii eye-tracking device was used in the experiment to record eye fixation and saccades. This information with the colour namings was analysed using the self-organizing map algorithm (SOM; Kohonen 2001). The participants (N=67) were from Asia, Europe, and Latin America between the ages of 24 and 55, with 33 males and 34 females using total of 15 languages as mother tongues, and living permanently or temporarily in Finland. The test photograph (Figure 1) was a bitmap image designed to fit on the Tobii screen and it was shown by Firefox web browser.

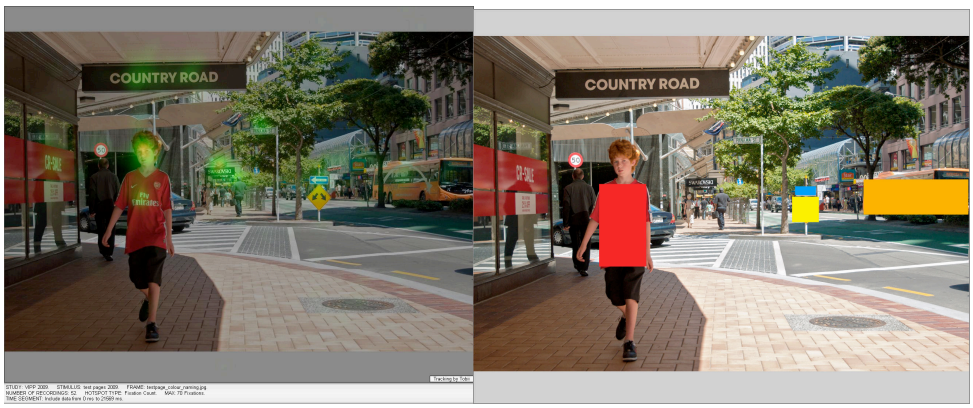


*Figure 1: On the left, the test photograph with combined hot spots of 67 participants added after tests. Hot spots indicate strong attention, e.g. human face and shop sign. On the right, combination of the five most important colours by test persons with the area where selection was made: Red, yellow, blue, orange and black.*

Participants were instructed to select at least five colours from the photograph according to their personal taste (Figure 1, right side). Language support for Russian and Asian languages such as Japanese, Chinese, Tamil, and Hindi was included. An input by clicking a mouse on a selected area resulted in a form of window where participants could type the name of the colour according to their own liking. After five colours participants were encouraged to name more colours if they wished.

## 3. RESULTS AND DISCUSSION

The test persons' colour choices were plotted into NCS colour space by converting the RGB data to visually defined colour regions in the NCS Atlas (colour data available at http://mlato.uiah.fi/cgi-bin/VIPP/admin/VIPPadmin). The defined colour regions were: black, white, red, orange, yellow, yellow-green, green, blue-green, blue, violet, purple, red, brown, pink and grey. The colours that were named most often were chosen for comparison of eye fixation data and colour naming data. These colours were red, yellow, blue, orange and black. Figure 1 shows how 1) the combined hot spots of 67 test persons (left) do not correlate at all with the colour naming (right), and 2) how selections and different colour terms of 15 languages cluster according to colour areas on the test photograph. Secondly, we combined all data to see possible holistic or analytic cognitive styles. The self-organizing map (Figure 2) combines information from both eye-tracking and colour naming data for direct comparison.

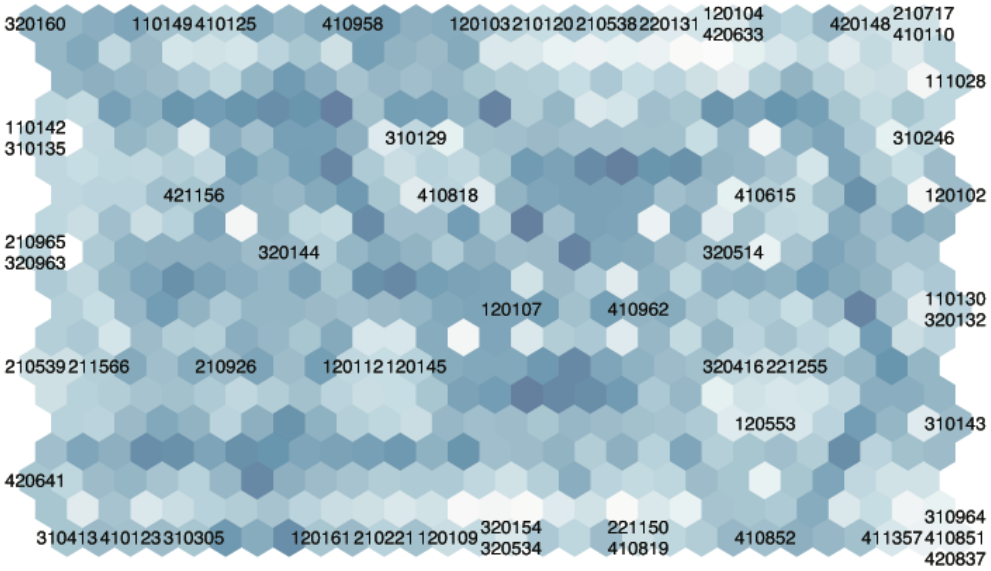


*Figure 2: An SOM with 55 participants (6 digit user ID: role 1-4, gender 1-2, language 01-15, ID 01-67, e.g. 310129 = media professional, female, Finnish, 29)*

The results showed discrepancies between sampled colours and named colours. For example a colour sample with a 'brown' appearance was identified as 'orange'. We suspect that this is due to other factors than wide divergences in colour categorization. In this experiment test persons were asked to name colours in an image of a natural spatial scene. As our data show, attention is drawn strongly to objects that bear information or emotional content: the boy's face, the signs and texts (Figure 1). These objects constitute a primary level of visual information, and they are overlayed with other visual levels, which are accessible through a more analytical approach. For example, the colours of objects are modified and defined spatially by light and shadow as well as reflected colours and highlights. Merleau-Ponty (2004) identifies two modes of attention: In *living perception* the 'real' colours of objects are apprehended despite the modification of their qualitative appearance, whereas in the *reflective attitude* the colours are perceived as if out of their spatial context. The experiment shows that participants often identified the 'real' colour, although the sample showed it as modified by the light. Our method does not recognize the difference between the apprehended 'object colour' and the modified colour.

## 4. CONCLUSIONS

In this work, we have devised an approach to comparing eye-tracking results with colour naming. We recognize the need to make clearer separations between cognitive styles and modes of attention in the future experiments. Also an analysis of the discrepancies between named colour and perceived colour might reveal differences in cognitive styles. Literature and web design practice indicate that holistic and analytic differences exist. In our initial experiments, we did not find clear evidence of these two major cognitive styles, although American, Azerbaijani (Russian speaker), British, Chinese, Finnish (both hearing and Deaf participants), German, Indian (Tamil and Hindi speakers), Iranian, Japanese, Korean, Portuguese, Turkish and Venezuelan people were recruited for the experiment. However, we understand the need to continue research about the plausible cognitive differences and their existence among holistically-minded people and analytically-minded people, in order to enhance the accessibility and usability of the web-based communication.

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*Address: Antti Raike, Aalto University, P.O.Box 11000, FI-00076 Aalto, Finland*
*E-mails: antti.raike@aalto.fi, harald.arnkil@aalto.fi,*
*jyrki.messo@ aalto.fi, timo.honkela@ aalto.fi*