

NEUTRAL GREY – AN ABSTRACTION?

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ABSTRACT

This paper presents part of the research project *Greyness and spatial experience*. Its main objective is to discuss the concept of *neutral grey* and to investigate the preconditions for perceiving neutral grey colours in different situations. *Neutral grey* is defined as having similarity only to black and white, not to the chromatic elementary colours.

Greyish colour samples have been observed with different backgrounds and in different light. One of these series is presented in detail in the paper, the conclusions from others are considered in the discussion, together with relevant literature. Greyish colours are seldom perceived as neutral, but rather tend to get a perceived hue, which depends on the observation situation. Inherent neutral grey colours are not found in nature. In production of materials and artefacts no tolerance level can assure a total lack of hue.

In conclusion we suggest that *neutral grey* should be considered as an abstraction, its unique but in practice unobtainable quality lying in its absolute lack of hue and chromaticness.

Keywords: Perceived colour, viewing conditions, unique colours

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INTRODUCTION: THE CONCEPT OF *GREY*

In NCS, the Natural Colour System, *greyness* is seen as a secondary, composite colour quality made up from the elementary colour attributes *blackness* and *whiteness*.¹ Neutral grey colours have only these two attributes and lack any similarity to the chromatic elementary colours yellow, red, blue and green. In other words, neutral grey colours have no hue. In the NCS they are denoted by an N. There are, however, many other colours than the neutral ones that can be called grey or greyish. Sivik & Hård have shown that some degree of *greyness* or *greyishness* can be observed in colours with a chromaticness as large as 45 on the 100-graded NCS scale.²

The colours that we perceive in a given situation depend on a large number of factors, and neither hue nor other colour properties can be defined or described with reference to the intensity or spectral distribution of physical radiation. The *nominal* properties of a colour sample are defined as its perceived colour in one specific situation, with standardised lighting, background and other viewing conditions. A grey surface which in that specific situation resembles only the elementary colours black and white, in different visual proportions, is a *nominally* neutral grey surface, it has a neutral grey *inherent colour*. For a discussion on the concept of inherent colour and a specification of NCS standard viewing conditions see Fridell Anter (2000).³

PREVIOUS RESEARCH: GREYISH COLOURS IN SPATIAL CONTEXTS

Earlier research on colour in spatial contexts implies that greyish colours outside the standard situation only seldom are perceived as neutral. Monica Billger and her students at Chalmers Architecture have investigated how the perceived colours in a large room with daylight vary with weather and time of

the day. One of the walls in the room had a strong red colour whereas the others had a medium light neutral grey inherent colour, and the floor was covered with yellow clinker slabs. The perceived colour of the greyish walls was shown to vary considerably over time, both concerning blackness/whiteness and hue. One and the same wall could, in different situations, be perceived as yellowish, greenish, reddish or bluish grey, and physically identically walls could assume contrasting hues when meeting over a corner. Very few of the perceived grey colours in this room were neutral.⁴ In her studies of perceived facade colour, Karin Fridell Anter has shown that facades with small chromaticness – greyish facades – tend to get a perceived hue that is less yellowish/ more bluish than their inherent colour. Only rarely they are perceived as neutral grey.⁵

OBSERVATIONS OF GREYISH COLOURS WITH DIFFERENT LIGHTING AND BACKGROUND

To investigate the relative occurrence of perceived neutral and tinted greys in a simple and controlled situation we carried out an observation series with 25 different A4 samples. Their nominal lightness varied from almost white to almost black. Five of them were nominally neutral, and the others were slightly tinted in yellow, red, blue or green. See Table 1.

Table 1. Nominal colours of NCS samples viewed with different lighting and background

Neutral	0500-N	2500-N	4500-N	6500-N	8500-N
Yellowish	0502-Y	2502-Y	4502-Y	6502-Y	8502-Y
Reddish	0502-R	2502-R	4502-R	6502-R	8502-R
Bluish	0502-B	2502-B	4502-B	6502-B	8502-B
Greenish	0502-G	2502-G	4502-G	6502-G	8502-G

The samples were observed in a large room with whitish walls. They were placed against a vertical background coloured white (nominally NCS 0500-N) or black (nominally 8001-R) and observed from a distance of 1½ metres. The room was lit either with daylight from north facing windows or with fluorescent light from the ceiling (Philips Master TL5 HO 54 W). Two observers (the authors) observed the samples in random order without knowing their nominal colour and independently answered the questions

- 1) Do you perceive any hue in the colour of the sample?
- 2) In that case, is the hue yellow, red, blue, green or something between two of them?
- 3) If the hue resembles two elementary hues, are they equally strong or does one dominate?

Table 2. Percentages of nominal and perceived hues. 200 observations.

Nominal hue	N	Y	R	B	G	Sum
Nominal hue	20	20	20	20	20	100
Perceived dominating hue	5	49	18	5	24	100
Perceived hue (dominating or not)	5	69	35	7	34	----

Table 3. Percentages of observations where perceived hue (dominating or not) was the same as nominal hue or where the colour was perceived as neutral. 200 observations.

Nominal hue	N	Y	R	B	G
Perceived hue = nominal hue	5	95	90	25	83
Perceived as neutral	5	0	0	1	8

Neutral grey colours were perceived in only 5% of the observations although 20% of the samples were nominally neutral (Table 2). This percentage varied only slightly (3-6%) between different background and light situations. The nominally neutral grey samples were not perceived as neutral more frequently than the nominally tinted samples (Table 3). This implies that our visual sense is very sensitive to anything that could make us perceive a surface as having a hue.

EXPERIENCES FROM OTHER OBSERVATIONS AND LITERATURE

The research project *Greyness and spatial experience* included several other observation series that will not be reported here. We will, however, summarise some experiences as a background for the concluding discussion.

- When placed in a classical infield-surround situation greyish infields very easily assume chromatic qualities which enhance the contrast. This is especially obvious when the two colours have no lightness contrast, which leaves hue as the only means of contrast. Colours with stronger chromaticness are less ambiguous. One can say that the grey samples borrow a contrasting hue to be clearly seen against their background, whereas the chromatic samples defend their inherent hue qualities. The qualitative change from achromatic to chromatic – or from e.g. greenish to reddish – has a stronger attention value than the quantitative change of, for example, a red colour turning into a somewhat different red.
- When seen in spatial contexts such as built rooms, all surfaces mutually effect each other through interreflection, and surfaces with no or only little inherent chromaticness easily take on the hue of the reflecting surfaces. As in the previous example this means a qualitative change with strong attention value.
- In our observations of greyish colour samples we found, that a long and intense observance of a sample often leads to a shift in its perceived colour. Rather than looking neutral, a greyish surface could visually oscillate between for example greenish or reddish, or could be gradually covered with “clouds” in a hue seemingly complementary to what was first observed.
- In our observations of greyish colour samples we also found slight differences between observers. These were sometimes random and sometimes systematic, which show that the perception of neutrality depends on the observer.
- Paints or other materials made with the aim of being neutral grey are very sensitive to different light sources, and only a slight variation of the spectral distribution can make them be perceived as “warm” or “cold”. These words tell that there is a small deviation from the strictly neutral, large enough to be perceived but too small to have a specified hue.
- If the samples that together form a “neutral” grey scale would have even minor chromaticness in different hues, the chromaticness would be enhanced by contrast effect and the samples would not appear neutral but rather having clearly different hues. To avoid this, producers of systematic colour charts like the NCS atlas have chosen to place the inevitable manufacturing tolerance of the nominally neutral grey samples towards only yellow and red.^{6,7}
- Even if they are named grey in everyday language, both natural materials like stone and manufactured materials like concrete tend to have a slight chromaticness, most often with a yellowish (“warm”) hue.^{8,9}

CONCLUDING DISCUSSION

As we have seen, colours that could be called *neutral grey* are very rare. This is true for both inherent and perceived colours. *Inherent colours* in our built or natural environment are seldom or never neutral, and even in such industry that is specialised on colour it is practically impossible to produce totally neutral coloured artefacts. *Perceived colours* vary with the viewing situation and the observer and are affected by light, simultaneous contrast against adjoining colours, interreflection between nearby surfaces and a number of other factors. Thus a greyish surface cannot give a constant colour perception but is due to assume varying hues. This leads on to the suggestion that the concept *neutral grey* should be regarded as a theoretical abstraction with its basis in our minds and not in the world of perceptions, in a similar way as the unique colours and hues.

The six *unique colours* yellow, red, blue, green, black and white form our mental references for colour perception. They have similarity only with themselves and are distinct perceptions in the same way as the perceptions of horizontal and vertical.¹⁰ The unique colours are theoretical abstractions which exist in our minds but cannot be perfectly produced or perceived. However red a surface might be, we can always imagine something that even more resembles our inner reference for red. This is an accepted

notion, and colour systems based on the unique colours, like the NCS, do not show samples for the absolute references.

We now suggest that not only the *unique colours* but also the *unique hues*, irrespective of chromaticness, should be regarded as theoretical abstractions. Perceived colours vary with the situation, and cannot keep exactly the same hue for any period of time, and for the unique hues any shift of hue, however small, makes them cease to be unique (for example a shift from NCS 3040-R to 3040-R01B). Inherent colours can never be exactly produced, and even the smallest variation tolerance would allow them to assume hues that are not the intended unique ones.

This brings us back to the concept of *neutral grey*, which correspondingly has a match only in our mental reference world. Fog has suggested that *Grey* should be regarded as a seventh unique colour.¹¹ According to the definition of *unique colour* this implies that we have an inner reference of a grey colour that resembles neither black nor white, a notion that has been strongly theoretically counter argued by Tonnquist¹² and experimentally falsified by Hård.¹³

Thus, the neutral grey is not a unique colour. Instead its unique quality lies in its neutralness, its absolute lack of hue and chromaticness. Such colours cannot be perfectly produced or perceived, which means that *neutral grey* is a theoretical abstraction.

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