

# THE SPACIOUS GREYNESS: ON COLOUR, LIGHT AND SPACE

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## ABSTRACT

In the project *Greyness and spatial experience*<sup>1</sup> we have studied visual qualities in grey/greyish colours “on location” in the - spatial - world around. We have carried out a number of observation series not only aiming to investigate variation of greyness in different spatial situations but also to develop a methodology and equipment for such studies. In this paper perception of greyness is discussed in relation to our own observations and to scientific and scholarly references. We make some basic reflections on colour in spatial context and in relation to traditional colour theory.

In spatial context colours with low chromaticness, near the grey-scale, play a more significant role than distinctly chromatic colours; hence they are very important in design of built spaces, both exterior and interior. The logically balanced distribution of greyness in shadows and in surfaces against the light produces a spatial feeling of coherency, and greyish inherent colours generally form a subordinated background to colours with high chromaticness. Simultaneously greyness to a high degree conduces to differentiation of spatial experience; an over-all spatial experience of greyness normally offers subtle but distinct contrasts of hue.

In the field of colour most scientific research deals with colour phenomena as such. If focusing on colour as spatial phenomenon, colour theory can be given theoretical connection to intuitive understanding of the world around and be part of a wider field of aesthetic research.

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## AESTHETIC EXPERIENCE AND INTUITIVE UNDERSTANDING

Man is a living creature in a three-dimensional, continuously changing reality. Our cognitive/perceptive systems are rooted in this fact and the dispositions, controlling the development of how we understand the world around, have been formed in this context. All sensory structures contribute to the experience of a spatial and continuously changing world, but the most important spatial sense is sight; the visual perceptive/cognitive structures that organize our visual experience have a larger capacity of information processing than other sense areas have. Information from the outer world is transformed into a complex and dynamic inner image made up of spatially structured colour and light qualities; every perceptual pattern that is possible to interpret as a spatial structure is always spontaneously given such an interpretation.

In the field of colour theory most scientific research deals with colour phenomena as such. If focusing on colour as a spatial phenomenon, colour theory can be given theoretical connection to our intuitive understanding of the world around and be part of a wider field of aesthetic research

We perceive the surrounding reality – and ourselves – present in time and space, in relation to the world around, in change and in motion, as it were, spontaneously. The world appears as *aesthetic surface*<sup>2</sup>: we perceive patterns of colours, shapes, sounds, scents, tastes and tactile structures inseparably woven together with feelings and earlier experiences. The project of aesthetic philosophy is to describe this kind of perceptive intuitive understanding.

Today cognitive scientists take a special interest in neurological processes behind intuitive comprehensive understanding. With new methods they can explore and confirm earlier hypotheses and assumptions about aesthetic understanding, originally posed by philosophers and art researchers within an epistemological tradition. Among others, the American philosopher Susanne K Langer, who published her most important works in the forties, has now attracted renewed attention; achievements in cognitive psychology have updated her philosophical discussion about aesthetic experience as an act of intuitive understanding.<sup>3,4</sup> Even if aspects and terminology are different, philosophical aesthetics and scientific psychology are now beginning to get a common focus.

Susanne Langer uses the term *semblance* for the sensitive qualities and structures that we perceive.<sup>2</sup> *Semblance* is a synonym of Friedrich Schiller's 'Schein' and Susanne Langer has borrowed it from C G. Jung. The experience of aesthetic semblance is not conceptual; it is an intuitive, comprehensive and complex experience based on sensitive apprehension of the world around us. The primary mental structures that form our overall impressions are natural; they are innate functional dispositions in perception interacting with and adapting to the outer world. In cognitive psychology the term used for this basic perceptual level is *categorical perception*, which means, *that a reality without well-defined borders by our perceptual mechanisms is divided up into distinct units.*<sup>5</sup> Hence the categorical perception is in some respects determined genetically, but to a large degree acquired in direct contact with the outer world. The categorical perception is our basic adaptation to the world; it fits us into time and space; conceptions that - according to Immanuel Kant - constitute our experience of the world.<sup>6</sup> An increasingly complex adaptation of our cognitive ability takes place in the continuous, functional and dynamic interaction with the world around; direct and indirect experience and knowledge are gradually integrated on basis of the categorical perceptual principles. Our spontaneous experience of the world around is made up of this dynamic totality.

Experience of colour is essential for visual experience, for categorization and evaluation of objects and – most important – for intuitive understanding of space. Even very small differences in nuance or hue can mediate vital information about light and shade, distance and size, and in this connection colours with low chromaticness, near the grey-scale, play a more significant role than distinctly chromatic colours; hence they are very important in design of built spaces, both exterior and interior.

In this article colour terminology is adapted to the Natural Colour System, Swedish standard for colour notation.<sup>7</sup> This means, among other things, that the term *chromaticness* is comparable to (Munsell) *chroma* whereas *saturation* has got another meaning, as discussed below. The term *inherent colour* is used for the colour that can be visually assessed through comparison with colour samples, defined under standardised viewing conditions.<sup>8</sup>

## THE COHERENCE OF GREYNESS

The basic purpose of perception and cognition is to form a whole and cohesive experience of the world around. Our visual system has to balance between chaos and order, diversity and unity, striving to differentiate one thing from another and - at the same time - keep up coherence in a world of constant changes. The richness of information is essential to our understanding of the outer world. Just as essential, however, are intuitive coherence and perceptive constancy. This is made possible through such as resemblance of colours and understanding of spatial coherence. In this connection greyness plays an important part

When discussing the importance of colours for our experience of the world around, attention generally is concentrated on distinctly chromatic colours – yellow, orange, blue, green, etc. Hue often is presumed to be the most vital quality of colours, and there is no doubt that bright colours with high chromaticness attract attention. This is, at least partly, due to the fact that chromatic colours are not so frequent in the surrounding world. The dominating colours in both natural and built spaces have nuances with relatively low chromaticness. Fresh grass has an inherent colour far from the most intense green and most of the colours in nature have relatively low chromaticness; sand, stone and soil in Swedish nature never have an inherent chromaticness above 20 on a scale with 100 steps.<sup>9</sup>

Throughout history, most pigments suitable for outdoor use have had rather low chromaticness, due to technical and economical reasons.<sup>10</sup> Thus, in general more or less grey/greyish colours form a subordinated background to colours with high chromaticness.

Experience of greyness has a close connection to perception of shade, and light is a precondition for shade. In reality what we call daylight is not *one* kind of light but is continuously changing, in its spectral distribution of radiation and in its intensity. At the same time daylight is characterized by the fact that all wavelengths in the visual spectrum are represented and continuously distributed without leaps. Hence a complex variation is a directly significant quality of daylight, and a quality that can hardly be re-created in artificial sources of light. Even if ambition is reduced to creating a light source with spectral proportions of radiation equivalent to an ideal, but static, daylight, it shows that this is almost impossible to achieve. The ultimate daylight is nothing but an agreed theoretical construction, and the CIE (Commission Internationale de l'Eclairage) has presented mathematical models for a number of standardized sources of light, among others the daylight-imitating D65 (ISO 10526:1999/CIE S005/E-1998). Thus, to the producers of light sources ultimate daylight quality is just an ambition to strive for.

The visual system has adapted to meet the varying spectral distribution of radiation and to give an experience of a constant outer world. Hence colour constancy does not only concern the lightness, but also the hue of the surfaces we observe. The spectral distribution of radiation influences how we perceive colour, but perceived colours vary much less than differences of spectral proportions could lead us to presume. Our sense of colour adapts to the existing light conditions; we perceive a specific object to have almost the same colours irrespective of variations of light. Colour constancy implies, however, that the light source emits light with a continuous spectrum and that our vision is given time to adapt to a situation. Such light sources are incandescent lamps, natural daylight and open fire. Light sources with a discontinuous spectrum make the perceived colours differ more from the inherent ones both in nuances and hues, as has been shown in several studies.<sup>11</sup> When a room is lighted by two different light sources at the same time, for example incandescent and fluorescent light, we perceive colour differences even if we know that a surface has a homogeneous inherent colour.<sup>12</sup>

In addition, a surface is not only lighted directly by the source (-s) of light, but also by reflected indirect light from surrounding surfaces, which means that colours from different surfaces in a room "contaminate" each other and make them look more similar than perceived separately. Reflections from chromatic surfaces in the surrounding space may give a hue to nominally neutral grey surfaces, and less chromatic surfaces with the same hue, strengthen each other's chromaticness if put together in the same room. Chromatic surfaces with different hues may instead weaken each other's hue and make the totality slightly greyer.<sup>12</sup>

The experience of shading cannot be isolated from the understanding of a spatial structure; to perceive something as shaded, a spatial structure is required, and it is almost impossible to determine whether an isolated surface without obvious spatial connections is shaded or has a darker greyish inherent colour. In a spatial context, however, we normally have no problems making distinctions between the kind of greyness that appears in shades and the greyness of inherent surface colours.<sup>8</sup> To make this distinction we depend on several phenomena: the transition zones between light and dark, where the borders can be sharp or diffuse,<sup>13</sup> the spatial logic in relation to the place of the light source and the direction of the light, and small differences of spectral energy distribution between differently illuminated surfaces.<sup>14</sup> Sometimes the differences in energy distribution are large enough to make us consciously perceive the shades as coloured, but normally the differences are very small and add to our understanding without any consciously observed difference of hue. When there is no distinctly perceived hue, but still a feeling of it, the shade or the grey colour often is called "warm" or "cold".

When energy radiation reaches our eyes, its absolute spectral composition is not registered. Instead, the contrasts between different parts of the field of vision are registered and make up the basis of our visual perception. In the course of evolution our vision has adapted to daylight from the sun and a blue or cloudy sky, and it is also in this context that we can observe the most typical example of coloured

shadows. The lightest surface – snow being the most extreme example – is illuminated by both direct sunlight (with relatively more of long-wave radiation = “warm” light colour) and diffuse light from the sky (with relatively more of short-wave radiation = “cold” light colour) and is perceived as absolute white by what can be called *the whiteness principle*, i.e. the tendency within a field of vision to perceive one colour as white, relating all other colours to it. The shaded parts are illuminated only by light from the sky, our vision compares the radiation quality at the border between lit and shaded, registers the relative absence of long-wave radiation in the shade and makes us perceive a bluish hue in the shaded parts. Thus, in daylight shading leads to a change of hue from yellow towards blue, a decreased chromaticness in yellowish colours, and an increased chromaticness in bluish colours. Nominally neutral colours become bluish when shaded.<sup>8, 15</sup>

In one of our observation series we observed greyish colour samples in a shading box, where the samples were lighted with daylight and everything else in the field of vision was painted black and without light. In this situation most of the samples were perceived as almost white, in spite of the fact that they had a dark grey inherent colour with a nominal blackness = 85.<sup>1</sup> Most often, but not always, the lightest colour in the visual field tends to be perceived as white, as has been thoroughly discussed by Alan Gilchrist and his research team.<sup>16</sup> In a coming project we intend to investigate the relevance of the whiteness principle for colours with some nominal chromaticness.

In an interior situation with artificial light of one type – from incandescence lamps, fluorescence tubes or other sources of light – there are no differences in distribution of radiation. In such a situation the total illumination is created by an interaction between the radiation qualities of the light source and the reflection capacities of all surfaces in the room. Shaded surfaces are not reached by direct light from the light source and are therefore relatively more influenced by reflected light, which may result in shades coloured by the surrounding surfaces.

The transition from light to dark in shades is characterized by gradients of colours with *the same saturation*: the visual proportion between chromaticness and whiteness is maintained when blackness increases with decreasing illumination. Hence chromaticness decreases in shades – the colour not only becomes darker but also turns more greyish. This promotes our ability to identify shades and help to tell the difference between shades and surfaces with dark inherent colours. With increased illumination surfaces becomes lighter, and at the same time the perceived chromaticness increases and the hues becomes more distinct in – even slightly – chromatic colours. The changes in lighting and shading are, however, not reverse: in shading a very chromatic inherent colour may be almost neutral, but lighting, however strong is it, can only accomplish a very small increase in chromaticness in a faintly chromatic inherent colour.

## THE DIFFERENTIATED GREY

Through the existence of shades, greyness is constantly present and functionally necessary in spatial contexts. It is essential for making space a coherent whole, but also greatly contributes to a differentiation of the spatial experience; variations of lightness – spontaneously interpreted as spatial patterns of shade and light – are the most important dimension of spatial understanding.

Greyish colours have a high potential of lightness variation. They are also able to maintain their greyness and at the same time show all the hues. What we call grey is very seldom *neutral-grey* but offers subtle but distinct contrasts of hue within a coherent greyness. This can be caused by the already discussed coloured shades or, in concurrence, by simultaneous contrast effects. Simultaneous contrast enhances the colour differences between coloured surfaces bordering each other in the same plane, often by adding or enhancing complementary hues. It easily makes greyish colours assume a perceived hue; one could say that greyish colours are “easily led” as compared to more chromatic colours.

When trying to describe the colours of the walls in a room or the surface of an object we usually use simple colour words; we say that the room or the object is red, green, white, grey etc. By a comparative observation, however, we can without difficulty see that the walls of the room or the

surface of the object do not have that colour; what we perceive is the result of an intuitive interweaving of a great variety of different lights and colour experiences. This can be clarified by using the concepts *identity colour* and *colour variations*.<sup>12</sup> In our spontaneous understanding of the outer world the perceived colours of rooms and objects are apprehended in relation and in contrast to each other as integrated parts of visual/spatial dynamic structures. When, in a spatial context, contrasts of lightness and nuances are so low that the spatially informative visual borders are “in danger”, they are “saved” by increased visual contrasts. Similar colours are perceptively grouped into patterns creating order and comprehensive totality.<sup>17</sup> Light causes form shadows, which give information about volume, and cast shadows, which help us to understand the extension of space in different planes. The silhouettes of surfaces against the light and the distinct lightness in direct lighting help the understanding of our spatial relation to the sources of light. On rugged surfaces the equally and finely scattered distribution of light and shade gives the impression that they are darker than their inherent colour. Spectral distribution of light radiation also influences the variations of colours of a room. Hence the logically balanced distribution of greyness in shades and in surfaces against the light produces a spatial feeling of coherency, and simultaneously greyness to a high degree conduces to differentiation of spatial experience.

## COLOUR THEORY IN THE REAL WORLD

To great extent contemporary colour research deals with abstract qualities of colours, without placing them in their context of space and light. In spite of the fact that they are mentally inseparable phenomena, colour and light together have attracted less attention. In traditional colour theory greyness is looked upon almost as some kind of negation to (chromatic) colours, while, as we have seen, greyness in the spatial context is fundamental to spatial understanding; greyness makes for understanding of light and shade, background and foreground etc.

It is true that colour and light as such mediate no spatial information. Spatial perception demands relations of positions and size, directions, gradients and enclosure. The American philosopher David Prall remarks that you *cannot make a spatial whole except with elements the very nature and being of which is spatial extension. (--)* *The elements must lie in an order native to their very being, an order grasped by us as constituted by a relation. We call structures intelligible (--)* *in so far we find them capable of analysis into such elements so related.*<sup>2</sup> Colour as such has no given extension in space; it has to be carried by something *the very nature and being of which is spatial extension*. Colour has no other formal structures except colour qualities related to other colour qualities (i.e. contrasts in lightness, whiteness, blackness, hue or chromaticness). If colour phenomena are abstracted from their natural connections to light and spatial order, causal relations behind them become inconceivable and mystified.

The fact that there could be objections to reduction of colour to abstract qualities, however, does not mean that colour systematics are unimportant; colour systems are important as references in scientific, artistic and practical work with colours, but colour systems are tools for description and analyse, not colour theory in a wider meaning of the word.

Studying and analyzing the appearance of colour in spatial contexts is one way to widen our understanding of colour phenomena described in traditional colour theory. Our project *Grey colours and spatial experience* is an attempt in this direction. Another way could be to attend to artistic experience: to demonstrate, test, analyze and systematize pictorial space in works of art. In the European tradition of art, artists intuitively try to form pictorial expressive symbols<sup>17</sup> of light and space. Hence pictorial art is a potential source of systematic knowledge about experience of colour in spatial context. We cannot, however, refer to pictorial art as examples of *how we perceive* the world. Painters choose different ways of transferring real space into pictorial space. Leonardo da Vinci in a portrait makes a shading in the face as a scale of colours from light to shade with the same saturation. Rembrandt uses a special scale from deep to white colours to express strong light contrasts in a *clair-obscur* painting. Monet uses colours in the same nuance to express even sunshine or misty weather in a landscape painting. Paintings seldom show what is actually there or even what the artists

actually saw. What artists present are pictorial structures that we, with our perceptual dispositions and visual experiences, may understand as shadings, even lighting etc.

The attention structures of the artists give usable references to further systematic studies. In art we can investigate what kind of visual experiences the artists have tried to find pictorial expressions for. The “notations” of the artists can help to pay attention to special perceptive structures or be the basis of hypotheses, be tested in spatial context and integrated in a coherent theory about colour and light in space. Cézanne in his ambition to find a *pictorial language parallel to nature*<sup>18</sup> interprets the perceptual distinctions with contrasting complementary colours; he does not make an illusory reproduction of the subject. When he simultaneously looks for a pictorial parallel to the perceptual constancy his solution is to use colours of the same lightness. His choices of colours are not arbitrary subjective. They are not always a result of conscious considerations, but never creative whims and absolutely not a “matter of taste”. Leonardo da Vinci uses a dark-light contrast scale of colours in the same saturation and near the greyscale to solve the combined problem of constancy and differentiations; the lightness contrast makes the pictorial elements distinct, the overall grey toning gives unity. This does not mean that the world is overall greyish to Leonardo, but that such a perceptive structure gives an impression of coherence.

Perception of differences and similarities of colours and of interaction between colour and light is essential to our experience of a meaningful and coherent outer world; the basis of such visual phenomena should primarily be looked upon as spatial. Our experiences of intuitive significance in colours and colour structures are to a great degree a direct consequence of what it means to be human beings; colour phenomena and significant perceptive patterns are related to inner constituting inherent order and/or perceived logical structures in the world around. An epistemological perspective on colour phenomena would make colour theory a coherent but still interdisciplinary area of research.

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