Colors: From Dispositionalism to Subjectivism

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Abstract

The present MA Thesis is about the nature of the color and consequently the theory of the perception of color. The main concern is to solve the historical problem of how to relate color as an experience with the cause of it or physical properties of the bodies. Dispositionalism, developed by John Locke, seems to present the solution. But, as the analytical and comparative approaches in the investigation significantly reveal, Locke even deepens the gap between physicalism and subjectivisms. As the results show Locke only tries to show the third possible way or dispositionalism. What makes thesis special for philosophy is that it is based on the newest empirical facts. So, I can easily obtain some physical arguments against dispositionalism and present subjectivist arguments against pluralistic realism that was recently developed by Mohan Matthen. His fascinating tendency to involve the significance of the visual apparatus in philosophy of perception seems to fade away in comparison to the latest discoveries made in neurology. Since the significant organ responsible for the perception of color is our brains, color perception depends on each individual. Therefore it is subjective, but still caused by distal stimuli. The significance of this MA Thesis lies in the development of new subjective view on the perception of color that is broader, which would add to the general question of what colors are from the ontological and epistemological point of view in philosophy of colors.

Acknowledgements

My supreme appreciation goes to Professor Michael V. Griffin. His comments, corrections, and guidance, as a lecturer and enthusiast throughout my study, truthfully engage me to approach the subject matter from different perspectives and into development of my own view. Griffin's endless encouragement and support as a superintendent significantly influent on the accomplishment of this work. I feel deep gratitude to all professors at the Central European University, who helped me to enlarge my knowledge. A special thanks goes to Professor Nenad Miščević, for support and numerous pieces of advice colleagues at the Central European University, and Maribor University for the assistance and giving me directions in the course of writing the thesis.

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Introduction

Color experience plays a vital role from the very beginnings of humans and probably some animals as well. This survival tool might have helped our ancestors to avoid danger, like the colorful poisonous animals, and to find food by easily distinguishing leaves form fruit. Even nowadays it is hard to imagine life without color experience, since it is indispensable in diverse empirical fields, such as astronomy, physics, medicine, psychology, art, ecology, and so on. Color sensation enables us a faster communication; for instance green on traffic lights means go, while red means stop. Moreover, knowledge that solar energy is attracted to black objects makes the possibility for saving energy; in medicine different colors might mean a sign of a specific disease, in astronomy it is used to specify different magnitudes, and so on. It seems that color experiences help to create our lives; they make us feel good or irritated, suppress our appetite or increase it, or even improve our mental and physical health. Although there is a flow of empirical researches of how color perception works and which are physical properties of the body responsible for the appearance of color experience in us, it seems that the question what is color as such cannot be answered in a straight line, but it rather slips away when different theories and accounts try to catch it and domesticate it.

The greatest problem in philosophy of color is how color fits into a scientific explanation of the world, more precisely into the physical account on the one hand and psychological explanation of color experience on the other. In the seventeenth century, Galileo (1957) tried to give an explanation of nature of colors in the language of mathematical physics. Galileo treated all qualitative characteristics of reality as sensational effects produced in us by a world that was essentially quantitative in character (Johnston, 2004). But this view is not without problems. In his book *The puzzle of experience* Valberg (1992) explains well why color should not be treated as something physical. He states that empirical researches give us a clear explanation of the causal processes in visual perception[1]. But, experience is at the end of the causal chain and it is directly responsive merely to the last bond. So, "if the activity in my brain were to continue as it is, my experience would continue as it is" (Valberg, 1992, 25). In other words, although when there is no physical object around, one might still experience color, because of the neural activity of certain sort. Therefore the physical object that we observe is most likely irrelevant and not even identical to the character of the experience. But,

[1] Explanation is given in the chapter *1.2 The Empirical Facts about the Nature of Color.*

as others think, this might not hold, since it is common sense that physical objects are the object of experience, when we observe them (Clark, 1994).

Valberg goes further and presents the example of the book itself, which is the physical object. However, when one reads the book s/he experience diverse scenes, colors and characters that book does not seems to present. With regard to that Valberg came to the problematic ending that concerns the existence of 'sense datum' (Valberg, 1992). Following the examples of these sorts, many scientists and philosophers refuse the statement that color is a physical property of physical objects and therefore presume that the character of colors must be at least to some extent exemplified in language of our mental states. But, some philosophers still accepts the Galilean idea of color that can be expressed in purely quantitative language.

Nowadays the gap between objectivism and subjectivism concerns the contrast between external physical world one the one side and psychological or neurological approach to the explanation of the nature of color on the other. Further, the following question for philosophy of perception of color remains: how can it be that physical world that is composed of various fluctuations, such as electromagnetic 'spectrum', creates in us vivid experiences of color in such a way that we almost believe they are really something outside on the objects? Beside subjectivism and objectivism many theories have been developed in order to narrow the gap between physics and psychology.

Dispositionalism is one of the most established views today, according to which color is the feature of the physical world that is disposed to produce the experience in the normal perceiver in standard circumstances. John Locke (1975) is nowadays presented as one of the first philosophers, who argued for dispositionalism. However, my reading presented in Chapter 2, suggests that Locke can be read from the perspective of physicalism (color is a disposition of the object, related to and manifested in the presence of light), and dispositionalism (color is a disposition, manifested in a presence of the normal perceiver), as well as from subjectivism (color is experience caused by the qualities of the object). This 'ambiguous' philosopher even intensified the old clash between the strict physical world and the way we perceive it. The conclusion is that Locke is not a dispositionalist, strictly speaking.

I think that subjectivism is the best solution for the philosophical quarrel about the nature of color. As Boghossian shows, dispositionalism is problematic. With regard to that I bracket the

first, distal, part of the causal chain of visual perception and move further to the specialties of different visual apparatus. In order to show that neural activity is the most important for our visual experience, I take into consideration Mohan Matthen's ecological view that carefully take into account all sorts of species endowed with color perception. His main idea is that color as such is something external that we all can perceive in different ways with regard to the function of the visual apparatus properties we possess. I tried to answer the following question: the activity of what in our visual organ as whole is responsible for the experience of color?

I found the answer in the field of neurology that tries to find out what causes the visual experience of a given shade of color on the basis of the examination of certain sort of malfunctions and disorders. The case of synaesthesia that is not addressed in the philosophical debate to the extent it should be, shows that the specific parts of the brain are responsible for the specific type of visual experience. This should exercise a considerable influence on the debate in philosophy of mind, namely in the dispute about whether qualia exist. It is evident that neurologists agree on their existence, because it offers the possibility to distinguish between different shades of color that we experience. I argue that *color is the sensation caused by a certain neural activity.* This view allows the existence of hallucinations, and it agrees with the notion that the sensations of the same type might be caused by different sensory organs.

This thesis is of some importance for a possible new direction of development of subjectivism, since it uses the latest discovered empirical facts about the relation between the neurological activity and qualia. For me, a part of the motivation for writing the present MA Thesis was to address these empirical facts stemming from different fields, namely physics, physiology and neurology. Philosophers sometimes overlook such facts in specific fields. For instance, physicalists should become aware of empirical facts discovered in neurology. In addition, the objections in philosophy of perception are usually made against old general and limited theories about the nature of the color. That is why arguments against subjectivism are mainly against limited version that does not allow the existence of the physical world. Indeed this seems to be the easiest way to go, but if philosophers want to make some improvements, the theories that are at most possible and the newest empirical researches should be always taken into consideration.

I hope that I have clearly shown that physical facts about the world, that are often, but to my mind, erroneously identified with color-facts, very different form the function of our body that is constituted on the bases of neural activity and mental states; where to my mind the color is situated. Perception is a human activity, limited to the perceiver, and it should be treated as such; taken into account all her/his special characteristics. That is why color should be treated in the first place in relation to the relevant mental state that is caused by neural activity rather then by some uniform feature of external reality.

In my opinion, this version of subjectivism is worth studying in an in-depth manner, since it might present the solution to the tough question of dualism in the philosophy of mind. I think that a more strict definition should be given. In addition to this, the characterization that I propose for the perception of color should explain the relation between neural activities and color experiences or qualia as such. The arguments for the existence of qualia and the nature of qualia might be presented in further development. (To anticipate the chapter on Matthen, in my opinion ecological view is something new and I think it should be carefully analyzed. Perhaps it might help to develop the broader version of subjectivism that would present the final solution of defining the perception of the color as such.)

The methodology used in MA Thesis is entirely qualitative. Largely the critical approach, the method of analysis, comparison and description are employed. Descriptive method was used to define the historical problem of locating colors and the theories about the perception of color. Analytical and comparative methods were used to define the color as such according to Locke. Further, the pluralistic realism is presented and objected by the empirical facts. The methods of generalization, comparison and analysis are used and sometimes intervened. The results and evaluation of them are presented by synthetic and descriptive method.

Let me anticipate. In the present work I will first introduce some major theories about the perception of color and empirical facts that serve as a support for my thesis. Further I will describe and analyze Lockean view about the perception of color, since his ambiguous terminology offers us the distinction between three major views. Here I reject dispositionalism in favor of subjectivism. I analyze Matthen's arguments for action-pluralistic-realism and show on the basis of some neurological facts that subjectivism about the perception of color should hold. At the end the brief conclusion is made and the possibilities for the further development are proposed.

1 The philosophical theories and empirical facts about the perception of color

The main concern of theories of color concerns the constituting nature of it. Subjectivism has developed as a response to the realism or corpuscular ideology. According to the realism colors are considered as properties of the objects, since we attribute them to the object. The main argument for physicalists is that colors as properties of the objects look nearly the same through the time and that color looks as if it were the property of the physical object. With the development of psychology some responded to physicalism that the physical world does not possess the colors in the same way we experience them. Imagine an uninhabited, bare world full of physical facts, without an individual, who would experience it in a colorful way. Color is, I shall argue, more like pain and something subjective, since it cannot be explained or measured in the way physical properties, such as shape, mass, or size can be.

The theories of the nature of color investigate the constituting nature of the color, meanwhile the theories of perception deals with the problem of how to relate explanatory quantitative physical facts, namely wavelengths of certain sorts, with qualitative color experience; moreover it posses the question of why color seems to be perceived as the property of the physical object. What theory of color perception one chooses mostly depends on the proposed theory of color one settles for. For example, if one takes color as a mental qualitative property of visual states themselves or theory called subjectivism, then according to the problem of perception of color one has to give the answer to how can it be that mental qualitative property seems to be perceived as a property of mind-independent objects (Eliasmith, 2008). So, the basic question about the nature of color - whether physical objects are colored - has lead to development of two conflicting theories of perception of colors, that is, physicalism, according to which colors are physical properties[2], and eliminativism, with regard to which physical objects are not colored[3].

2 The father of this view is J. J. C. Smart.

3 The classification of theories of color perception was primarily made by Byrne and Hilbert (1997). In the same vein it was developed also by Cohen (2009) and Aboites (2009), for the basic problem of subjectivism and objectivism see Ross (2001).

1.1 Philosophical theories of the perception of color

1.1.1 Subjectivism

Eliminativism is the type of subjectivism about color, which reaches back to the early Greek atomist Democritus, who put the question of how color can find a place within the physical world if it ultimately consists of colorless atoms in the void. Philosophers, such as Descartes and Locke, on some readings, followed Galilean thought that modern science straightforwardly shows that physical objects are not colored. Many contemporary color scientists are of the same opinion. However one has to be aware of the distinction between eliminativism and subjectivism in general. According to eliminativism there is nothing to be the referent of 'red'; in other words there is nothing that is color in the world. Subjectivists admit the existence of color experiences with which I agree. C. L. Hardin for example, argues for the existence of the sensational property and simply denies that experiences veridically represent objects as being colored (Byrne and Hilbert, 1997). Hardin claims "we are to be eliminativists with respect to color as a property of objects, but reductivists with respect to color experiences" (Hardin, 1988, p. 112). That is, he denies that objects are colored and in addition qualia or color experiences can be reduced to neural processes. The difficulty of how to describe mental colors[4] arise mainly because of the distinction between the view that mental color concerns what is like for the perceiver to be conscious of color[5] and the view according to which mental colors are to be described in terms of causal relations; e.g., functionally described processes of our visual systems[6].

1.1.2 Dispositionalism

In contrast to eliminativism dispositionalism takes color as physical property. According to dispositionalism color is a disposition to produce a certain perceptual state, roughly the disposition to look blue. Locke as one of the first dispositionalists[7] argued the following: "a Violet, by the impulse of such insensible particles of matter of peculiar figures, and bulks, and in different degrees and modifications of their Motions, causes the Ideas of the blue Colour… to be produced in our minds" (Locke, 1975, E. II, viii, 13). Locke claims that an idea of blue does not 'resemble' anything in the violet. Following that Locke thinks that violets, although

4 As oppose to objective colors held by physicalism.

5 Mental color according to this view is typically called quale (sing.) or qualia (plural); for instance Peacocke, McGinn, Shoemaker, and Block.

6 For instance Hardin, Clark, McGilvray, and Lewis.

7 See also Boyle (1979), and Descartes (1970). A precursor is Galileo (1957).

they are represented to be blue, are not actually blue, in the sense that violet is primarily made of qualities, such as shape, mass, and size. That is why Locke is treated as eliminativist in one way (Byrne and Hilbert, 1997). On the other hand Locke is treated as dispositionalist, because one of the properties that physical objects have is a secondary quality or "power to produce sensation in us" (E. II, viii, 15). As we will see in this thesis his view on colors as dispositions can be mistaken due to Locke's ambiguity in his terminology.

1.1.3 Physicalism

Physicalism about color is broadly speaking the view that colors are physical properties that we sometimes veridically perceive objects to possess. The leading idea behind physicalism is not so much that colors are physical properties, but rather that colors are to be identified with properties whose natures (a) are specifiable in ways that do not employ our color concepts, and (b) are not constituted by relations to the psychological states of perceivers. Because physicalism is reductive according to (a), it is classified as 'objective' meanwhile dispositionalism is classified as 'subjective'; but this might be misleading. Armstrong holds objective version of physicalism and maintains that "physicalism cuts all logical links between color and what happens in the perceivers of color"[8]. Byrne and Hilbert identify color with a disposition that has a specific influence to the light, meanwhile Harman proposes that color is dispositions to produce a certain response in normal perceiver, where the appropriate response is recognized in part by the apparatus of color perception"[9]. On the other hand Jackson and Pargetter identify color as categorical base of the disposition that is recognized by science as a physical property of some kind (Byrne and Hilbert, 1997). As one can see some version of physicalism seems to be quite close to dispositionalism.

1.1.4 Primitivists

Primitivists like physicalists argue that objects are colored, and go against dispositionalism that that color is disposition to produce certain perceptual state. Color, according to this view, seems to be closely line up to what is typical called 'primary quality', i.e., shape. Primitivists may also hold that colors do not even supervene on physical properties of objects (Byrne and Hilbert, 1997).

8 See, Byrne and Hilbert (1997), chapter 3 (the objective version of physicalism is hold also by Harman, Byrne and Hilbert).

9 See, Byrne and Hilbert (1997), chapter 13, p. 259.

1.1.5 The ecological view

The ecological view has been recently developed by Thompson *et al.* (1992)[10]. In search for the answers how color is perceived as a property of physical objects Thompson considered color perception in diverse species from the evolutionary point of view. According to that view different species have developed color vision to carry out certain biological functions that should be explained in ecological language. The ecological view strives for the correlation between perception and action, and persists that the "animal and environment" should not be treated as "fundamentally separate systems" (Thompson, 1992, 21); in other words properties of the environment are supposed to be partly 'composed' by visual observation. According to Thompson "colours are properties of the world that result from animal-environment codetermination in particular… and are not already labeled properties in the world which the perceiving animal must simply recover" (ibid. 21). The ecological view is perhaps best seen as a version of dispositionalism, identifying the colours with 'ecological-level dispositions' to affect perceivers (Thompson 1995, 751). However, Byrne and Hilbert stress that the proponents of the ecological view see the contrast to traditional dispositionalism as fairly shallow. They mention palpable obscurity of the ecological view, which is that one of the crucial components of the theory seems to be difficult to make clear; i.e., the claim that colours are "codetermined" by the observer and its surroundings (Byrne and Hilbert, 2000).

1.2 Empirical facts about the nature of color

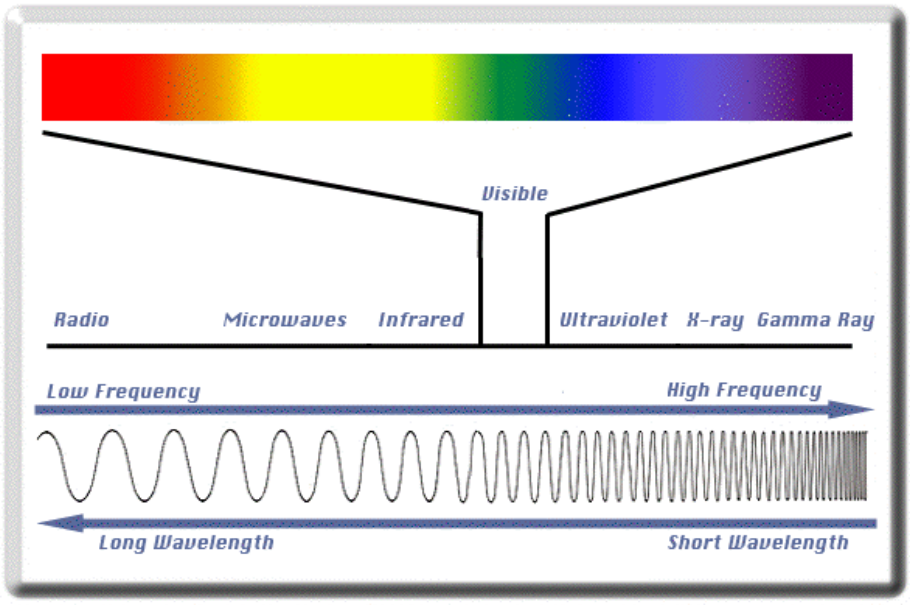
In revealing the nature of color one should attempt to incorporate philosophical concerns with the empirical facts, such as physical properties of the objects, neural facts and psychological facts about the nature of the experience itself. Further concerning theories about the perception of colors it is important to clarify the functioning of the visual apparatus, the transmission of the information from the eye to the brains, and the neural activity that produce a certain experience. The study of color perception is broadly explained by the spectral power of allocation of light that is incoming in the retina. On one hand there is the scale of different light rays that can be defined by the electromagnetic fluctuation and on the other hand there is the spectrum of color that is perceived. We should emphasize here that there is no assumption that the patterns of light correspond to any possible arrangement of surfaces, objects and illuminants in a three-dimensional scene (Maloney, 1999, 387). Following that the old quarrel

10 Thompson was inspired by J. J. Gibson (1987).

between colour physicalism and colour subjectivism is still relevant. The main question is whether color is something external or independent of the one who perceives it[11] (visible light) or it is something internal; e.g. it is located somewhere in our brain or more precisely it is a product of our brain[12]. I will introduce some physical and psychological facts about the perception of color and afterwards some of the latest discoveries in the field of visual perception that serve as important arguments for subjectivism.

The science shows that the visual apparatus perceives the visible light (700 nm[13] to 400 nm), which is only the small part of the electro-magnetic specter that can be perceived by our visual apparatus. From the figure 1 it is clear that there are also other waves like radio, IR, UV, etc. There is a distinction between the frequencies of the light waves,[14] which affect the color perception, and the amplitudes of the light waves[15] that affect the observation of brightness (Kuehni, 2005).

Figure 1: The electro magnetic spectrum



Source: http://www.lcse.umn.edu/specs/labs/glossary_items/em_spectrum.html

11 Following the theories such as physicalism, primitivism and dispositionalism.

12 Subsequent to subjectivism and projectivism.

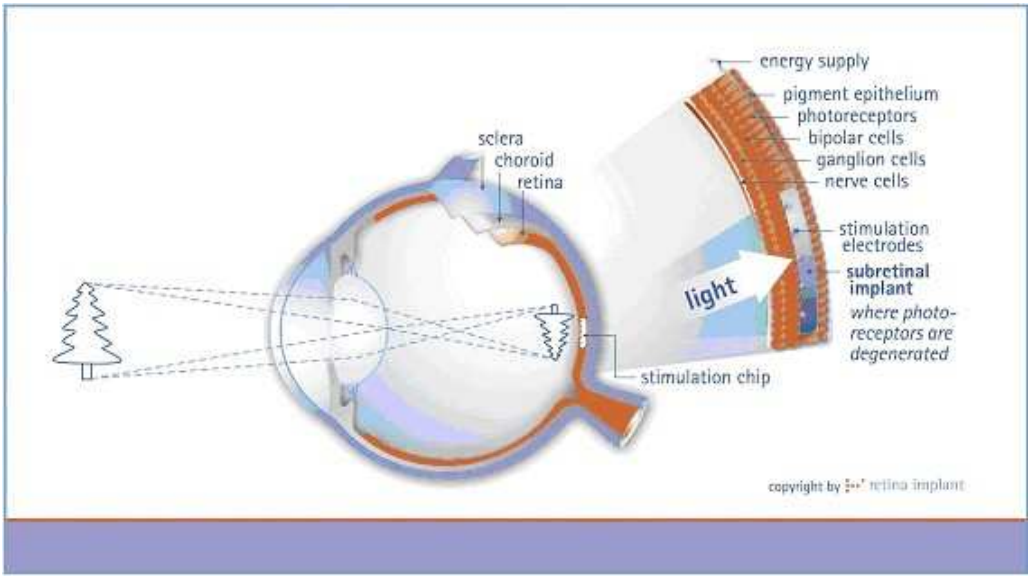
13 Nanometer (nm) is a unit of spatial measurement; i.e., 10-9 meter.

14 The frequencies of the waves - the longer a wave, the less often it occurs.

15 Amplitude of the light waves presents the altitude/height of the wave.

The visible light signals enter the pupil[16]. Following that cornea[17] and lens[18] invert the signal and project it on to the back of the eye where the retina[19] is located (see figure 2). There the light signals are absorbed by the two-dimensional, curved layer of light-sensitive cells, which convert the light signal into a neural signal[20]. Species, those are able to perceive color, have the specialized area of the retina, called fovea that is composed of photoreceptors (rods and cones). The rods are not color sensitive and are used for the vision in a dim light, meanwhile cones are color sensitive (Molavi and Essen, 1997).

Figure 2: Visual perception of the eye



Source: http://www.uni-ulm.de/en/in/institute-of-microelectronics/research/topics/biomedical-implants/circuit-design-for-medical-implants.html

In the experiments, done in 1964, Young-Helmholz trichromatic theory shows that each human cone cell can only absorb one of the three segments of the spectrum (Pines, 2008, see

16 Pupil is opening at the center of the iris which controls the amount of light entering the eye.

17 Cornea - the round, transparent area that allows light to pass into the eye.

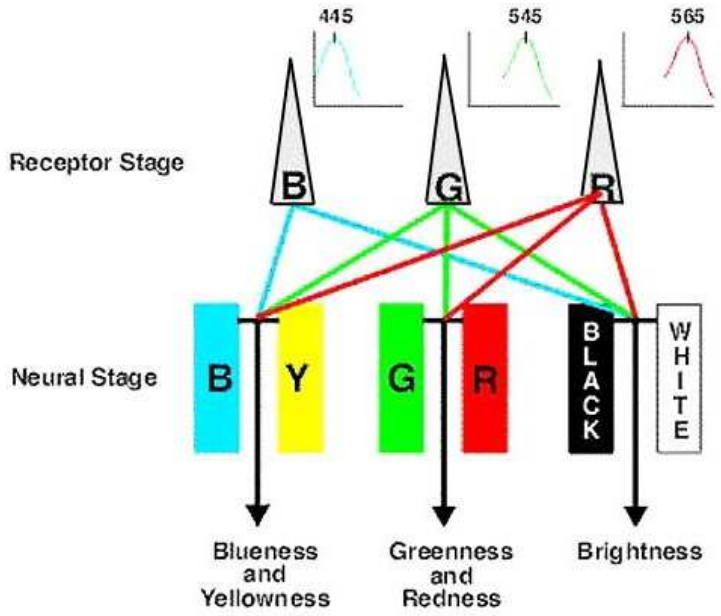
18 Lenses are the transparent structure that focuses light onto the retina.

19 Retina - inner membrane of the eye that receives information about light using rods and cones. The functioning of the retina is similar to the spinal cord - both act as a highway for information to travel on.

20 This process is known as signal transduction.

also Riggs, 1967). In the figure 3 blue the absorption pick is at cc. 445 nm, green at cc. 535 nm, and red at cc. 575 nm.

Figure 3: Model for normal human vision



Source: http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=webvision&part=ch28kallcolor

Further, the opponent-process theory of color perception was developed by Hurvich and Jameson (see, Hurvich and Jameson, 1957). As it can be seen from the figure 3 each photoreceptor B, G and R, respond to only one color (e.g., receptor R respond only to red) and it blocks the opponent color (e.g., red). At the neural stage there are three opponent pairs: red-green, blue-yellow, and black- white (see Byrne, and Hilbert, 2000). That means that human beings can perceive only all of the possible mixtures of blue, red and green and nothing else[21]. However, after the photoreceptors agitate the bipolar cells, which incite the ganglion cells, the electrical signal travels via the optic nerve carries the visual information to the primary visual cortex, V1 in the brain[22]. The information from the two eyes is assorted and it produces the binocular vision (Molavi and Essen, 1997).

21 As we will see in the chapter III some species can perceive also UV rays as colored.

22 I will not go into details of how the electrical signal travels, since it would take to much space and it is not central for the theory I will defend.

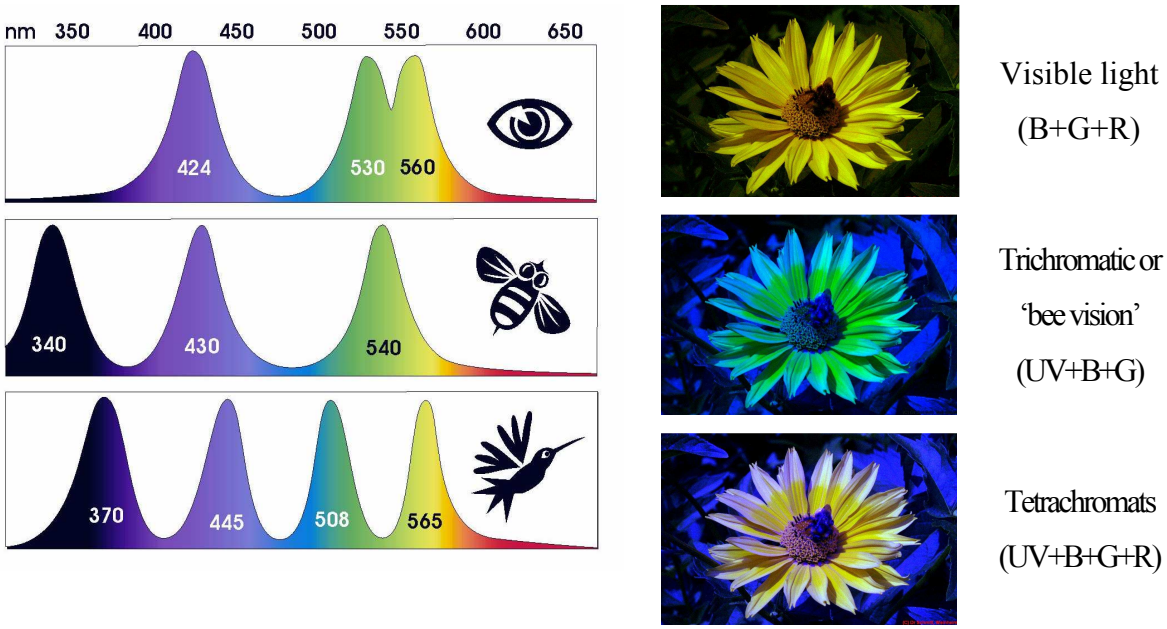
1.3 Empirical facts as the arguments for subjectivism

The empirical facts seem to clearly present the visual perception of color. But, do psychophysical facts presented give the solution to the philosophical problem what is the nature of the color? In other words, when one sees the color red, what is red, is it the physical thing, like the specific wavelength of the electromagnetic spectrum or it is the sensation produced by this wavelength? Further questions that might rise are: according to the fact that different species have different structure and function of the visual organs, is it possible that their color is different from ours? What is then really a color?

1.3.1 Perception of different species

Different species perceive the external objects differently. For instance, human being is trichromat, because there are only three types of light-absorbing photoreceptors. As the figure 4 shows there are three picks of the light absorption in the first row, since we have three types of cones. Photosensitive cells in some sorts, like honey bee, do not absorb the red color, but on the other hand perceive ultraviolet spectrum as color (see figure 4, the second row). There are also some birds, fish and reptiles that have four visual pigments and can detect blue, green, red, and ultraviolet waves.

Figure 4: The flower perceived by certain species



Sources: see Table of Contents

There exist also some non-primate mammals, such as dog, that are dichromats, and a few nocturnal mammals, which have only one pigment cell and can perceive different shades between black and white. So, different species perceive 'bare physical world' in different way and consequently the experience of the unique colors are prescribed to the objects in a different way. This has lead to the development of a new theory about color perception, namely ecological view (Byrne and Hilbert, 2000) and it can be used as the argument for subjectivism, since color constancy is different for unlike species and the object outside of us seems to be different with regard to our visual apparatus[23].

1.3.2 Color constancy

Color constancy is the phenomenon that objects stay colored although they are exposed to different circumstances, such s candle light, sun light, electric lamp or other. This seemed to present one of the famous arguments for physicalism, since they argue that this is the property the objects possess. But, latest researches show that this is not so. Color constancy is the feature of human (and animal) colour vision, with regard to which, perceived color is rather insensitive to alteration in illumination in different conditions. Some cognitive scientists explain this by treating colour vision as a system that extorts information about the surface properties of objects, or more exact, their reflectances, from the light reaching the eye (Jacobs, and Nathans, 2009). There are plenty of experiments that speak in favor of subjectivists account. For instance in the journal *Neuroscience*, Williams is strappingly suggested that our perception of color is controlled much more by our brains than by our eyes[24].

1.3.3 Metamerism

The empirical phenomenon that a given color perception can be caused by widely varying reflectance or spectral power functions is known as metamerism (Kuehni, 2001)[25]. For example, it might be the case that one perceives identical colors, call it blue, despite the fact that colors are the results of the surface with unlike reflecting character. This is the result of the fact that all the information obtainable by our visual apparatus originate only in three cone-types (Byrne, and Hilbert, 2000). Kuehni claims: "it is clear that there is no simple 1:1

23 See the chapter III Beyond dispositionalism – Matthen's pluralistic realism

24 According to the experiment participants were wearing colored contacts 4 hours per day. But, after several weeks, when they were not obliged to use contacts the shift in the color perception occurred although they were not wearing the colored contacts. This is acc. to scientists a direct evidence for an internal, automatic calibrator of color perception (Williams, 2005).

25 See also Rosenthal, David M. (2001).

relationship[26] between such signatures and the resulting experiences" (Kuehni, 2001, 25). This answers the philosophical question whether color experience can be explained by the physics. The answer is indeed no.

1.3.4 Synaesthesia

Synaesthesia is "the rare capacity to hear colors, taste shapes or experience other equally startling sensory blendings whose quality seems difficult for most of us to imagine" (Cytowic, 1995, 7). In response to certain stimuli some sensory phenomena are elicited that are automatic and cannot be turned on or off (Ramachandran, and Hubbard, 2001). According to Ramachandran and Hubbard (2001) there are two distinctive groups of synaesthetes: the higher synaesthetes who do not require the external physical stimulus to induce the synaesthetic experience[27]; this is usually the case with the grapheme-colour synaesthete (tested by Dixon, taken from Macpherson, 2007) and the lower synaesthetes whose synaesthetic experience is triggered only in response to a sensory stimulus (Cytowic, 1993 and 1995, 21). As Ramachandran, and Hubbard claim "studying synaesthesia may help us to understand how the brain segregates and integrates different sensations and thoughts" (Ramachandran, and Hubbard, 2001). Would that mean that color as an experience is generated strictly by the brain? In my surprise there seems to be very little written about synaesthesia in philosophical debate, although there is a vast of reports and new researches in the area of neurology[28] that supports Valberg's idea that color is strictly something subjective and it is not identical to physical properties of the objects.

26 It seems that Kuehni here refers to the Hume's principle according to which the number of Fs is equal to the number of Gs if and only if there is a one-to-one correspondence or a bijection between the Fs and the Gs. Hume's Principle appears in Frege's Foundations of Arithmetic (from Book I, Part III of Book I of A Treatise of Human Nature), see also Rayo (2007).

27 They only need to think of the synaesthetic stimulus in order for the synaesthetic effect to occur.

28 Synaesthesia serves as the arguments against functionalism, see Macpherson (2007). There is also discussion going on whether it presents the treat for representationalism, see Alter (2006), and Wager (1999).

2 Locke - from dispositionalism to subjectivism

Locke is in general regarded as a dispositionalist about color. According to that view color is a disposition or more specifically a power that bodies have to produce certain idea in normal perceiver under standard circumstances. For example the redness of an object consists in a disposition of the object to look red to the normal perceiver under normal conditions (Pitson, 2006). The stock examples of dispositional properties in contemporary philosophy, are solubility, fragility, elasticity and etc. (see Pitson, 2006, and Crane, 1995). Disposition is such property of the object that changes under the certain conditions; sugar dissolves in the water; glass breaks in suitable circumstances. Meanwhile the fragility and solubility are dispositions; the breaking and dissolving is the manifestation of the disposition. Dispositions are significantly used to describe the world. We avoid things that have a disposition to be poisonous and take care of the things that have a disposition to be fragile and so on (Crane, 1995).

Since dispositions are not causes[29], they are not necessarily manifested. That is why Goodman claims those dispositional predicates are applied to the object with regard to their possibility and not actual occurrence. For example the property of being sleep-inducing is not the cause by which person falls asleep; it is the chemical structure of the pill. In the case of soporificity and color perception, they are both second-order properties (Crane, 1995). Reflection of a certain wavelengths is a disposition object has, when exposed by light. Further disposition of the object produces the experience of red, when the perceiver with normal visual apparatus is observes it. Therefore disposition "might, be realized by another disposition" (Crane, 1995). Since dispositions usually are unobservable, and are in a sense 'directed on' categorical properties[30] or manifestations, Armstrong disputes that the truth-maker for a dispositional statement is always its manifestations (Crane, ed. 1995, *see chapter 1 Armstrong's view*).

Although dispositionalism is the account that most philosophers have concluded about Locke, still many of them call the attention for the inconsistencies in his work *An Essay Concerning Human Understanding* and the contemporary definition. Curley even claims that "those unfortunate inconsistencies for which Locke's work is so famous" (Curley, 1972, 440). Lowe

29 See Jackson, Pargetter and Prior 'Three theses about dispositions' American Philosophical Quarterly (1982).

30 The expression 'categorical property' is broadly used for color experience (see, Crane, 1995, and also Matthen, 2007).

understands Locke as a dispositionalist, but yet he founds him "ambivalent about some of these matters and perhaps even a little confused" (Lowe, 1995, 52). Jacovides on the other hand argues that Locke is strictly speaking subjectivist about colors (see, Jacovides, 2007). It seems to be obviously that no truthful and cautious reader of Locke's work is safe against all the allegations of inconsistency or carelessness[31].

Locke tries to solve the problem of perception and to relate color, as the feature of the object, to color, as the experience. Analysis shows how Locke's ambiguous terminology leads him to the conclusion of subjectivism and a sort of relationalism, and not dispositionalism as many would say. Some read him even as physicalist, but I will not go into details about this account. Although Locke did not solve the old philosophical quarrel, it gives me the source that leads to the subjectivist thesis of color as such. Let me first introduce the distinction between ideas, qualities and powers; further I will introduce arguments for subjectivism.

2.1 Ideas in our mind

The only idea that we can form of a substance consist of the ideas of the experienced 'powers' together with the obscure idea of something to which they belong, and which is responsible for their occurrence altogether (Ayer, 1991, 38). According to thesis of representationalism, Locke would say that "ideas are the immediate objects of experience and knowledge" (E, IV, xvii. 8). Every Man's Reasoning and Knowledge, is only about the Ideas existing in his own Mind: and our Knowledge and Reasoning about other Things, is only as they correspond with those our particular Ideas" (E. IV. xvii. 8). According to Locke "simple idea 'contains in it nothing but one uniform Appearance or Conception in the mind, and is not distinguishable into different ideas" (E. II.ii.1).

Meanwhile the perception is propositional; idea is representation of content to the mind[32]. It must be involved in any kind of state of consciousness or thought and it can determines the content of that thought, besides it can present object that does not exist. That corresponds to the psychological distinction between sensation and perception[33]. Idea in the Lockean sense

31 For the ambiguity between the terms 'idea' and 'quality' in E. II.viii.8 see Ayer (1991), Curley (1972), Jacovides (2007), Lowe, (1995), and Stuart (2003).

32 According to Descartes the Lockean distinction between perception and sensations seems to be problematic. The term 'idea' is ambiguous, being employed either for representative modes of thought or for their objects as they are conceived of, as they exist objectively 'in the understanding'. But I will not go into the details of this problem here.

33 See the chapter 4 Subjectivism.

means the passive representation of data from the exterior world into the body and to the brain or shortly sensation. On the other hand perception indicates the active process of picking, systematizing, and understanding the data brought to the brain by the senses. On the question of the relation between ideas and events in the brain Locke was officially agnostic. He did not ruled out the possibility that they might be identical, and he seems to believe that physical mechanisms are comprehensively involved in sense-perception, as well as in memory and imagination (Ayer, 1991, 51).

2.2 Quality and power of the body

Locke defines 'quality' as the powers…to produce ideas in our mind…by the operation of insensible particles on our senses" (E II.viii.8,13). Secondary qualities[34], just like primary produce ideas in us, and therefore we define them as qualities of the object. This goes hand in hand with the corpuscularian theory of perception that Locke defends in E II.viii.11-14. He presupposes that everything is made out of small particles; i.e., the body produces sensations "by Reason of its insensible primary Qualities" (E II.viii.23). Because we are able to perceive bodies close to us by touch or at a distance by sight, it follows that there must be something that intermediates between us and the perceived bodies. If we cannot perceive the particles that intermediate they are probably imperceptible. Therefore, our sense organs are affected trough impulse of small insensible particles since alternative forms of corporeal interaction are inconceivable (McCann, 1994, 62).

Locke distinguishes between active and passive powers, which can be explained by tertiary qualities. For example the sun has an active power to melt the wax. Wax on the other hand has a passive power to be melted by the Sun. In the same way object has the active power to produce a certain idea in us and we as the perceivers are only a passive observers. All these qualities of the object, the Sun, the wax, other objects have the power to produce ideas in us (E. II. viii. 22). Further we have to take into consideration the distinction between primary and secondary qualities.

34 The distinction between primary and secondary qualities reaches back in the time of Democritus, who had along to Heraclides, Parmenides, and Anaxagoras, claimed that color like sweet and bitter, and hot and cold, is color only by convention, because in truth there are simply atoms and the void (Guthrie, 1965, p. 439). Locke actually followed more modern Galileo Galilei: "I think that tastes, odors, colors, and so on are no more than mere names so far as the objects in which we locate them are concerned, and that they reside in consciousness. Hence if the living creature were removed, all these qualities would be wiped away and annihilated" (Galilei, 1623).

In Book II, Chapter viii of *An Essay Concerning Human Understanding*, Locke distinguishes between primary and secondary qualities[35]. Primary qualities are elementary properties, such as solidity, size, shape, number, motion of the minute constituent parts of body, and sometimes texture. They can never be divided from a body. Locke clarifies that by the following example: "if we divide a grain of wheat into two parts, each part has still solidity, extension, figure and mobility" (E. II.viii.9, see also II. viii. 22), which follows from the idea of corpuscularism. On the other hand secondary qualities like: colour, smell, taste, sound, light and tangible qualities are explained as "nothing in the objects themselves, but powers to produce various sensations in us by their primary qualities of their insensible parts" (E. II.viii.10). Locke basically defined secondary qualities as powers to produce ideas in our minds and named them 'secondary' because they depend on the primary qualities (E. II.viii.10, 14, 23).

Powers according to Locke can be explained in two different ways (Jacovides 2003, 332-33). All qualities of the object are in a robust sense powers, because they produce the applicable ideas in us. For example, the violet produces in us simple ideas like specific shape, color, and odor. But, secondary qualities are "…are *nothing in the Objects themselves*, but Powers to produce various Sensations in us *by their primary Qualities*" (E II.viii.10). Secondary qualities are bare powers produced in a certain conditions[36] and exist by primary qualities (E II.viii.10). More precisely secondary quality is "only a power to act differently upon other things: which powers result from the different modifications of those primary qualities" (E. II. viii. 23).

The distinction between robust and bare powers is supported by the resemblance thesis with regard to which 'bare' powers do not give a explanation of the corresponding actuality. As Locke states "the Ideas of primary Qualities of Bodies, are Resemblances of them, and their Patterns do really exist in the Bodies themselves; but the Ideas, produced in us by these Secondary Qualities, have no resemblance of them at all (E. II.viii.15). The main idea here is that ideas of primary qualities represent intrinsic, mind independent, real qualities and on the other hand the ideas of secondary qualities represent merely powers to produce ideas in us.

35 For the distinction between bare powers and robust powers by Locke see also Bolton 2001, 111.

36 In the case of the color perception the light is needed for secondary quality to produce idea in us.

The reason for that can be find also in the thesis of inseparability that will be presented as the partial argument for subjectivism.

2.3 Arguments against Dispositionalism

2.3.1 Dependency thesis – the first stage

According to Locke primary qualities are real qualities[37]; sometimes called also original qualities[38]. Locke describes 'real qualities' as the one that are really in the body, because they are in the body intrinsically. This means that primary qualities do not change when the circumstances are changed.

We have to be precise, when Locke uses expression 'color'. Here I will describe his first stage of dispositionalism. Color as secondary quality or disposition depends on the presence of light. As Locke mentions in quite fashionable way "the color is produced by 'different refraction of pellucid Bodies[39]'" and "the Colour and shining of Bodies, is in them nothing but the different Arrangement and Refraction of their minute and insensible parts" (E IV.xvi.12). It seems that Locke claims that different arrangement and refraction of the light from the prism produce color; i.e., in modern language visible light.

The example of microscopic eyes tells us that "if one could see much better, the colors that we see would 'disappear' and be replaced with 'an admirable Texture of parts of a certain Size and Figure' (E. II.xxiii.11)[40]. This shows Locke's commitment to corpuscularism. The porphyry example is also one of the most cited in philosophy of color perception:

"*Hinder light from striking on porphyry*[41]*, and its colours vanish; it no longer produces any such ideas in us*…Can any one think any real alterations are made in the porphyry by the presence or absence of light; and that those ideas of whiteness and redness are really in porphyry in the light, when it is plain *it has no colour in the dark*? It has, indeed, such a

37 Locke mentions 'real qualities' at II. viii. 17, 'primary and real qualities at II. viii. 22, 'real original qualities' or 'primary qualities' at II.viii.23, and 'original qualities at II. viii. 12; II. x. 6.

38 See, II.viii.23 and II.xxiii.9.

39 According to Jacovides Locke must have in mind prisms and the like (see Jacovides, 2007).

40 The same example was given also by Maier (1968) 66-67.

41 Porphyry is an igneous rock containing the large crystals known as phenocrysts embedded in a fine-grained matrix.

configuration of particles, both night and day, as are apt, by the rays of light rebounding from some parts of that hard stone, to produce in us the idea of redness, and from others the idea of whiteness; *but whiteness or redness are not in it at any time, but such a texture that hath the power* to produce such a sensation in us (E. II. viii. 19).

In this paragraph Locke states two things. First, colors are in the porphyry only in the presence of light; second, porphyry does not really change when the light is blocked off. Therefore dependency thesis states: if a body undergoes a real change from being F to not being F, that change must depend on a change in constitution or because it acquired different fundamental explanatory qualities (Jacovides, 2007). Following that in E II.viii.20 Locke describes a phenomenon: "Pound an Almond, and the clear white Colour will be altered into a dirty one... What real Alteration can the beating of the Pestle make in any Body, but an Alteration of the Texture of it?" I suggest that according to porphyry example Locke thinks of genuine modifications as alterations of intrinsic qualities; i.e., primary qualities. Color as such is physical property of the object that exists in certain circumstances independently of the perceiver. But, this is inconsistent with the second stage dependency thesis according to which the existence of color depends on the presence of the perceiver.

2.4 Arguments for Subjectivist Reading of Locke

2.4.1 Dependency thesis – the second stage

Locke claims that the existence of color depends on the presence of the normal perceiver with the appropriate visual apparatus. Normal in this sense means that the organism is being able to perceive color. With regard to contemporary dispositionalist' view it does not matter whether this organism is an animal, although some might objects that color in such sense is limited to the human visual apparatus. For instance:

"*Were there no fit Organs* to receive the impressions Fire makes on the Sight and Touch; nor a Mind joined to those Organs to receive the Ideas of Light and Heat, by those impressions from the Fire, or the Sun, there would yet be *no more Light, or Heat in the World, than there would be Pain if there were no sensible Creature to feel it*" (E. II.xxxi.2)

This paragraph shows that the existence of color depends on the perceiver appropriate visual apparatus or fit organs in order to see the secondary qualities (see also E. II.viii.17, II.xxxi.2, and viii. 19).

According to the first stage of dependency thesis color is a disposition of the object to reflect specific wavelengths when expose by the visible light. Locke would explain that by the fact that secondary qualities are merely powers on the object, and are changed by the specific conditions, such as light[42] or that primary quality are changed[43]. Though color as secondary quality is a disposition, following stage two, color is disposition to produce a certain idea in a normal perceiver. Going even further into the second stage dependency color as an idea is not reduced to secondary quality, when it is not observed, but further to primary qualities[44]. So inconsistently, color exists independently of the observer and depends on the observer.

Not only that the 'two stage dispositionalism' seems to be a significant problem for taking Locke as dispositionalist, it also seems that dispositionalism should not be taken as the appropriate account about the nature of colors. But, let me further introduce some arguments Locke makes that appears to fit into subjectivist account about colors. This brings also some very interesting conclusions about the nature of colors.

2.4.2 Color and pain

For the comparison between ideas of secondary qualities (color) and pain (McCann 1994, 65-66) Locke follows Descartes's thought experiment of walking closer to the fire (Maier 1968, 49, 66). Locke tries to show that the idea of warmth resemble the external objects in the similar way as the idea of pain does. With regard to that the idea of warmth and the idea of pain situate the same relation to the external objects. Locke states that someone might consider the following: "…what Reason one has to say, That his Idea of Warmth, which was produced in him by the Fire, is actually in the Fire; and his Idea of Pain, which the same Fire produced in him the same way, is not in the Fire" (E. II.viii.16). According to dispositionalism that is only a support for resemblance thesis; i.e., the pain and the color like warmth do not resemble anything in the object. But let us take into consideration the following reasoning:

42 For instance see example of porphyry (E. II. viii. 19).

43 For the example see the case of changed color of almond (E II.viii.20), when their primary qualities are changed.

44 See, E. II.viii.17, II.xxxi.2, and viii. 19.

Q1: Why is Whiteness in Snow, and Pain not? (E, II, viii.16)

Q2: why is whiteness in Snow when "the Pain as an Idea that is the effects of that object, is not, when it is not felt? (E, II, viii.18)

A: Whiteness is no more in the object, than Pain is. (E, II, xxx.2)

Therefore the color is like pain, which is in us and not as the secondary quality outside of us. The main concern here is to answer the question whether color is taken to be the idea or it is taken to be secondary quality? Careful reading of Locke shows that he uses expression 'color' as ideas at II. viii. 8, 10, 19, 24, but on the other hand 'color' is taken as secondary quality at II. viii. 20 and 24. The interesting notion that Locke made is that:

"When we go beyond the bare Ideas in our Minds, and would enquire into their Causes, we cannot conceive any thing else, to be in any sensible Object, whereby it produces different Ideas in us, but the different Bulk, Figure, Number, Texture, and Motion of its insensible Parts" (E II.xxi.73).

Does that means that the existence of secondary qualities fully depend on the presence of the perceiver. If this is so, then colors are secondary qualities as relational. But still one might believe that colors are like pain only the ideas. For instance Ayer with regard to the Lockean corpuscular theory states that "all things that exist are only particulars" (E III.iii.6), and concludes that "the relevant idea that determines whether an object is to be called 'red' is thus only a particular idea in the speaker's head, and this can't steer us wrong, not matter what's inside the heads of others" (Ayers, 1991, 207-09). Ayer draws that from the Locke's claim that there would be no "Imputation of Falsehood to our simple Ideas, if by the different Structure of our Organs, it were so ordered, That the same Object should produce in several Men's Minds different Ideas at the same time" (E II.xxxii.15). This fits into account that although each organism perceives different color, each of them is for an individual equally real. That gives a support for the claim that color is relational rather than dispositional. In addition one might conclude that the relevant idea produced in the individual determines whether an object is to be called 'red'. This explains Locke's ambiguity, stated at E. II.viii.8 that idea is in the quality of the object. In other words Locke does not mean that idea is

actually in the object, but it denominates the object, which is a clear argument for subjectivism[45].

2.4.3 Denomination

According to Locke "words in their primary or immediate signification stand for nothing but the ideas in the mind of him that uses them" (E, III. ii. 2). For example "flame is denominated hot and light; snow, white and cold; and manna, white and sweet, from the ideas they produce in us" (E. II. viii.16)[46]. Following that the qualities of the bodies are denominated from the ideas they produce in us. For example the word 'blue' is in its primary sense the name for the idea, and it applies to qualities of the objects as a sort of extension (Ayer, 1991, 63). In the same vein Jacovides makes a distinction between primary and derivative sense of color. In other words only ideas are red in the primary sense of 'red' meanwhile physical objects may be called so in a derivative sense because they produce ideas that are red in the primary sense (Stuart, 2003, 63).

Aristotle in *Categories* developed the distinction between primary and secondary signification and introduces the notion of paronymy or denomination (Craig, 1998, p.390). For example just primarily signifies justice and secondarily the just person. The just person is therefore denominated from justice. Jacovides in his work appeals to Aristotelian work *Metaphysics*, where he speaks about organisms and apples. Apple is called 'healthy' in a secondary or derivative sense by its feature of making organisms healthy in the primary sense (see, Aristotle, 2008, Metaphysics, IV.2 1003a34- b1). In the same sense color is in primarily sense an idea and in secondary or derivative sense a secondary quality, since secondary qualities are names by the idea produced in us. Colors according to Locke are therefore not secondary qualities, but only the ideas in us. Secondary qualities still exist, but only as the cause of the ideas in us. Similarly Quine claims that "the reasonable philosopher may believe that barns are red without believing that any rednesses, either particular or universal, inhere in them" (Quine, 1980, 10)[47].

To sum up, although many read Locke as dispositionalist he is more plausibly subjectivist. His significance for my view is that the terminological problems and the problem of dual

45 See Jacovides, 2007.

46 See also E, II.viii.15-16, 22, and Ayer (1991), 63-64.

47 Similarly Galileo noted that, "tastes, odors, colors, and so on are no more than mere names so far as the object in which we place them is concerned, and that they reside only in the consciousness" (Galileo, 1957, 274).

dispositionalism present the doubt in dispositionalism as such. He has a reason to ask himself why color is not like pain; that is something internal. The hesitation of the great empiricist shows the difficulty of interpreting color as something external. Further the idea of denomination shows that the ambiguity might be solved when terminology (color as secondary quality and color as idea) is clear. I showed that dispositionalism fails, since it cannot be that color is presented as a dual disposition[48]. Therefore, I suggest that we investigate further the causal chain of perception and answer the following: if color is not something external, what it is; what plays the primary role in causing the color experience, visual apparatus or neural activity?

48 For arguments against contemporaray dispositionalism see chapter *4.1 Arguments against dispositionalism*

3 Matthen - from realism to subjectivism

Although dispositionalism seems to be problematic, taking color as physical property of the object that exist independently of being perceive needs a special investigation. According to physicalism there exist object with certain wavelength and it is usually experienced in a certain shade. But, how are related physical entities and experiences of them? Can experience be explained in the physical terms? Mohan Matthen's in his work *Seeing, Doing, and Knowing*. Matthen, like dispositionalists, makes a clear division between external physical objects or distal stimulus[49], which produce the perception in the observer with the appropriate visual apparatus. His approach is complex, because he argues for the realist version of color perception, he seems to have similar view to dispositionalism, although he persist that he is not dispositionalist and further he tries to explain color in a functional way, that is by the function of visual apparatus in different organisms. With regard to this he is close to ecological view of color perception. Matthen's quite compound account is therefore called action relative realism and because of that it is difficult to classify him into the specific theory of color. Since his theory bout color is so complex I will try to analyze the functional process of visual apparatus and his arguments against subjectivism.

The main distinction between contemporary definition of dispositionalism and Matthen's version is about the specification of color as a disposition of the object (Egan, 2008). According to dispositionalism color is a disposition of the object that has a tendency to produce experiences of a particular sort in perceivers. The experience of the object is the state of 'looks-colored'; e.g., 'looks-blue'. Matthen argues that color, as the property or disposition of the object, has a tendency to produce actions of a particular sort in the perceiver. Following that Matthen view is that "color is a property a distal stimulus appears to have by virtue of an act of sensory classification" (Matthen, 2007, 14).

The core idea is that the visual apparatus classify distal stimuli in specific categories. The sensed features are 'appearance properties'; similarly to dispositionalism 'the object appears or looks blue'. As Matthen states "Sensory systems classify and categorize: they sort and assign distal stimuli; i.e., external sense objects, to classes" (ibid. 2007, 13)[50]. Therefore, the object appears to have a property on the basis of the classification that is made by visual apparatus,

49 Distal stimulus means a surface spectral reflectance of the object that convey the information to the visual apparatus that classify it.

50 This is made by the empirical fact of three photoreceptors R, G, B, see the chapter 1 The empirical fact about the nature of color.

when it classifies it in a certain way (ibid. 2007, 14). Classification is made strictly by the visual apparatus and is independent of the external stimuli. Experience of a certain shade is the final product of the perception. Color vision is so described in a functional and comparative way. Matthen clearly states that "color classification is one that is generated from the processing of difference of wavelength reaching the eye, and available to normal color perceivers by such processing" (ibid. 2007, 167).

The contribution of Matthen's work can be seen in his deep analyses and comparison of the visual apparatus of different species. The account of the automatic function of visual apparatus is a great improvement in color perception. Matthen treats each sensation as a sign or symbol of a feature that is being attributed to an object. Sensory qualia merely signal the presence of certain sense-features. Organisms of different kinds need different information about the world and consequently, they have evolved sensory systems with different informational functions (ibid. 2007, 327).

Although according to Matthen color cannot be captured by the objectivist's theories of color perception, he rejects subjectivism about color and puts several objections to Hardin[51]. That is why I will manly focus on the arguments against realism. Further I will try to object the idea that visual apparatus plays major role in the perception of color. In my opinion neural activity is more significant. Since within the species there are differences in the perception of color, the experience is usually totally subjective. The relation between the experience of color and distal stimuli does not play the significant role in my account of perception, since the stimulation of neurons can already cause the experience of certain sort.

3.1 Realism

Following Matthen color is the property of something that is external to the species that perceives it. Color as such cannot be defined as some widespread experiential state that is gained by plethora of various visual systems. That is why color, according to Matthen, must be recognized as the feature of the distal stimuli that are grasped by the visual organs. In other words, although diverse species with different structure and function of the visual apparatus perceive the persisting color as the property of the object in its own way, they all perceive the same thing. Matthen develops the thesis called pluralistic realism, according to which plenty

51 As one of the major proponent of subjectivism.

of apparently varied physical features; i.e., visible light composed of various electromagnetic waves with different length and frequencies, are sensed by variety of species that developed the appropriate visual apparatuses in different ways. Since color experiences as the end product seem to be reduced to the unique quality or distal stimuli, this might be seen as a sort of reductionism. Characteristics of visible light, associated with functional, species-specific, standards of accuracy and the chance of mistake, are therefore objectively verifiable (ibid, 2007, 209).

Matthen argues against subjectivism, because he believes that perceived color can be specified by their physical counterparts; i.e., wavelength, reflectance, etc. In his eighth chapter Matthen endeavors to demonstrate that even peculiar individual sensory categories[52] can be explained by the exterior physical world. Matthen's argumentation for color realism follows Armstrong's correspondence realism. "To say that P is true is to say that this proposition corresponds to reality' (Armstrong, 1989). Matthen claims that the same goes for colors. Something in a distal stimulus corresponds to the perception of them. Matthen claims that "when distal stimuli appear to be the same color, there is some independent property they share and when they look different there is such a property in them that distinguishes them" (Matthen, 2007, 203).

Matthen developed his theory on the basis of what he calls Lewis's similarity space, according to which colors are parallel with the brain's activity (see, Lewis, 1969). When Matthen asks the question: what does a color have to be in order to be unique green, his answer refers to the robustly realist proposal made by Alex Byrne and David Hilbert (2003), who advocate that there is an unconditional right or wrong about colors. They claim that either 520 nm is unique green, or 525 nm is, or some other wavelength is, but not more than one. Matthen response is that "unique green has to be unmixed with blue or yellow. But what is it for a color in the real world to be unmixed in this way? We do not know" (Matthen, 2007, 203).

The perceptual experience can be physically specified. By "physically specifiable" Matthen means that the extension of that class can be described in the language of physics (ibid. 2007, 199). For instance, the split that we perceive between yellow and green happens somewhere

52 Sensory category is defined as the experience, and it is the product of the classification made by visual apparatus, see Matthen, 2007.

in the reality and it can be physically specified. The interaction between cone cells and the visible light is as objective as an interface with a computable device. If the reaction state of the perceptual experience is physically specifiable, then (acc. to Byrne), it conveys data about the physical world, where 'the world' consist of the observer's sensory system. More specifically "sense experience E (or neural state N) represents distal feature F in the action-relative sense for a member of species S if (a) F is the physically specifiable response condition of E (or N)" (ibid. 2007, 206). Condition (a), according to Matthen is required in order to maintain correspondence realism. He argues that these kinds of specifications are not restricted only to the laws of physics. Instead Matthen sets the limitations to the specific categories of color that visual system classifies. He gives an example of the specific composition of the ray of the visible light, which agitates exact receptors in the retina and argues that the opponent process system that follows stimulation of the visual apparatus is 'physically specifiable' (ibid. 2007, 142).

Matthen presents a simple thought example made by Lewis. Take the Hue-Saturation-Brightness space of red-green, blue-yellow, and black-white, gather metamers together, introduce the sharp boundaries of categoricity, take account of the fact that at the ends of the spectrum, light affects only one receptor, and that these colours are consequently very dark and difficult to differentiate and there you have the real similarity space of colours. Matthen concludes that "it is always possible to describe what a sensory system detects in physical terms; i.e. it is always possible physically to specify the response conditions of its various states" (ibid. 2007, 199)[53]. For example if one asks why are red and violet similar Matthen would answer that this is so since they are both experienced as reddish, the question that follow is why is this so? According to Matthen's realism it is because the opponent-processing system computes the potency of the center of the spectrum of the visible light relative to the ends.

Certain shade of color, such as blue is the property of physical objects, such as blueberry, sky, and violet, appear to have when visual organ co-classifies them in such a way[54]. The color experience is only a final product of the classificatory activity of the visual system. Remember the distinction between two distinct notions about color. Following that Matthen

53 See also Matthen, 2007, 204, 213.

54 Color vision is defined functionally as the visual discriminative capacity that relies on sensors that react differentially to light differing in wavelength only to ground differential learned (conditioned) responses (Matthen, 2007, 166).

argues for the position a) with regard to which color is something in the object that has a certain effect on species with the appropriate visual apparatus, as oppose to b) by which color is something internal, like experience and it is cause simulated by distal stimuli in certain conditions; i.e., when they are exposed by light and when the observer has the appropriate visual organ. Now, let me introduce some difficulties the first account is facing. In order to defend subjectivist account of color I will try to put reasonable objections Matthen's realism.

3.2 Arguments against realism

3.2.1 The component incompatibility

Hardin argues for the narrow subjectivism, or that colours are experiences that color-vision system produces in us. Red as such is therefore experienced as more similar to violet than to green. But this is not the case when we look at the prism that reflects the wavelengths. As it can be clearly seen from the figure 5, red is on the opposite side of the spectrum where violet is reflected. Green is in that case closer to green than to violet.

Figure 5: Visible light as the part of electromagnetic spectrum.

Source: http://www.bio.miami.edu/ecosummer/lectures/lec_foodweb.html

Hardin concludes that the physical properties that occasion experiences of red, green, and violet are not identical with red, green, and violet, or in other words colors in physical sense are not similar to the experiences of color. Therefore, color is not a physical property (Hardin, 2003, see also Matthen, 2007, 188-190). What Hardin is arguing for is that human color experiences inadequately correspond to the physical world. Color as physical entity is not real. In the same vein one might say that the taste of the chocolate does not equip us with the physical facts about the physical state of it. Subjectivist mostly rely on the thesis already described, such as opponency, according to which we perceive the world by opponent processing which cannot be adjust to the physical properties, which exists independently of

opponent-processing perceptual systems. As Hardin argues if red and green are incompatible component, then, since there are no physical counterparts of colour that are component-incompatible in this way, red and green are not identical with any properties in the physical world (Matthen, 2007, 188-190).

3.2.2 Metamerism

The empirical fact supports metamerism[55], according to which different wavelengths can produce the identical color experience. As Dedrick clearly states: "an indefinite number of response patterns may be causally responsible for token distinct, but type-identical, chromatic sensory states" (Dedrick, 1996). Color experiences are type-identical and can have diverse causal formations. The difficulty for Matthen and objectivism about color in general is therefore that they states that color is physical property, but how can you then explain the type-identity of color experience in terms of physical properties. Although Matthen suggests that we might be able to produce such machinery that would show us the correspondence between all of the possible mixtures of the wavelengths that produces in us sometimes even the same color experience, this seems to be quite implausible, since we have to take into consideration also insignificant differences between visual apparatus within one species and all the differences between different species. Dedrick further argues that subjectivism faces the same problem. He claims that neural states are not type-identical; meanwhile color experiences are (Dedrick, 1996). I do not agree with that, since each path of neural activity corresponds to each color experience. Relation according to latest discoveries in neurology is one-to-one.

3.2.3 The error theory

Matthen explains the error theory on the basis of errors in detecting distal stimulus or properties of the external objects. Although he argues that we might come to the clear explanation of experience on the basis of the function of visual apparatus and spectral reflectance, no species can perceive properties of the object in the correct way. According to Matthen's view the error theory becomes something like that: the color vision assigns distal objects to certain classes. Color sensation conveys to the perceiver the message that these classes correspond to some system-independent property. This message is false (ibid, 2007, 194). In addition Matthen states that "phenomenal space might contain structure that totally fails to correlate with anything in the structure of content..." (Matthen, 1992, 46) Therefore

55 See chapter *1.3.3 Metamerism*.

the biological function of visual apparatus fails to perform their representative tasks (see Dedrick, 1996). But, then one might ask why would color be something outside of us? In my opinion we should focus on the phenomenal character of color and conclude that color is something subjective. As Hardin states the experiences do not correspond to the external world, although they present image as it would be in the external world. The conclusion follows that the external things possess the properties such that we cannot actually perceive. Therefore we are mislead and mistaken about the external world. According to the thesis of component incompatibility experiences cannot be explained on the basis of physical properties of the objects (as opposed to Matthen) and that leads us to the conclusion that color is something phenomenal and not external.

3.2.4 Arguments against action relative realism

Following Egan (2008), Matthen is inconsistent when he argues for color realism. First, Matthen argues for the transparency principle, according to which what is needed for an individual to classify something as blue is only a particular visual experience of a blue[56] thing, or even only an electrical stimulation of the brain to generate a flash of blue, when there is no distal stimuli (ibid. 2007, 250). But, Matthen goes into greater extreme when he establishes the fundamental principle of color attribution. Secondly, Matthen establishes the fundamental principle of color attribution, with regard to which "'x is colored' is true if and only if x really is the color something visually appears to be when it presents the look of the specific color" (ibid. 2007, 257). Color "is the property something visually appears to have when it looks colored" (ibid. 2007, 256). Matthen named this thesis look exportation. This sounds more like dispositionalism about colors. But this is clearly unable to get along with Matthen's early thesis of transparency principle; with regard to which, the brain manipulation is sufficient for the experience of blue. Following Matthen's account, the individual whose brain are exposed to electrical stimulation and individual consequently experience the blue color makes a perceptual error, despite her/is inferential activities were not disrupted (Egan, 2008). The question I would like to expose is how can it be that color experience is attributed to some external physical object, if it can be clearly caused merely by neural activation in the brain? Let me introduce the distinction between Matthen's argumentation for the significance of the function of visual apparatus and later on my arguments for the importance of the neural activity in the brain.

56 Matthen uses for the example 'canary-yellow' color, but, for the sake of simplicity, I try to stay faithful to the color 'blue' in nearly all instances presented in the thesis.

3.3 Pluralism

As many other philosophers, Matthen argues against dispositionalism, because it seem that it insufficiently describes the perception of color for species that perceive color in different way as compare to the human beings. In doing that he refers to the Cartesian paradigm, according to which "there is no sensory image common to all kinds of animals, which all of them use to guide their specialized actions… perceptual systems focus on what is important for the organism's own activities, and leave out what is not" (ibid. 2007, 90). He puts the example of the honey bee, which segregates flowers to those, which have 'broken forms, such as stars and crosses' and one that have 'compact forms, such as circles and squares' (ibid., 2007, 40). This is important for bees, when they collect pollen, since blossoms have broken forms and buds, on the other hand, have compact figures. What the bees see is different from what the human visual apparatus perceive, since he does not separate the flowers. With regard to that Matthen ask the question: who is right about the color if different beings perceive the color in a different way?

For instance "we must accord to pigeon colors exactly the same authority as we have just ceded to the colors that humans experience. This need not violate logic. Properties--even physically specifiable properties--are infinitely numerous... why then can both not be correct" (Matthen, 2005, 202). His answer is that each species classifies distal stimuli in its own way, on the basis of its own purposes. Although the honeybee's visual apparatus classifies things in a different way than human being, both are right or "at least both of us can be capturing objective truths about the world" (Matthen, 2007, 91). Following that Matthen's answer to the question, what is the real nature of color, would be that there is not just one real nature of color. Pluralism in the sense Matthen defends should not be taken as 'relativistic' application. The properties that objects have, such as blue, should not be relativized to the observers. What is relativized are the truths about colour, which exist only by virtual of how particular species perceive the colour of the distal object. Since all species use the same information collected by wavelength-sensitive receptors, they are all bind to colour properties (ibid, 2007, 188-190). Pigeon experience of colors is distinct from the color experience of human being, but anyway various unlike kinds of observes all have veridical color experiences.

But, why is the activity of the visual apparatus so important? According to Matthen it seems that because it also explains why a certain species might perceive colors in the wrong way. Does a color-blind person perceive the world in the right way? Matthen claims that "an act of

classification is wrong if it disrupts a specialized function that the classification is supposed to aid" (Matthen, 2007, 206). In other words, color classification is used for making inductions concerning different unobservable features of objects. The classification can be disrupted in the weak or unusual light conditions or when the visual apparatus of the certain species cannot detect a certain shade of color. Matthen assumes that "most species are in evolutionary equilibrium most of the time" (ibid. 2007, 206), and argues that therefore "for most species now there is no mismatch between sensory capacities and innate sensorily guided activities" (ibid. 2007, 206). Species have a set of actions 'associated by evolution' with the development of that capacity. These constitute what Matthen names as 'innate sensorily guided activities', 'species activities', or 'specialized functions'. They are 'innate' in the sense that they are either 'genetically or developmentally specified' (ibid. 2007, 205). For instance, humans use color vision to maintain inductions about the edibility of food, pigeons on the other hand use color vision for aerial navigation. The malfunction of pigeons that categorize distal stimuli in the way humans do; i.e., according to trichromatic scheme, would be considered as incorrect, since it disrupts some specific inherently actions of pigeons. An individual is deficient just in case that individual is not able to appropriately perform the inherent actions that are typical for individual's species[57].

3.4 Arguments against pluralist realism

3.4.1 The brain adaptation

In my opinion it is mistaken to conclude, as Matthen does, that color is objective and something external only because many different species perceive the same thing. Experiences are caused by the physical properties of the bodies. One of the famous arguments for physicalism is also color constancy, according to which objects are colored as constant although light conditions are changed, because they emit wavelength of certain proportion through time. In special condition color is changed, when texture is changed. For instance some types of the textile change the color when exposed to the heat[58].

Despite this the latest researches in neuroscience suggest that our perception of color is controlled much more by our brain than by the distal objects or even by our sensory organs. Color constancy is only a psychological phenomenon that occurs on the basis of photo-

57 This species-specific outset of normality and deficiency is in accordance with Neander's, 1983 conception.

58 For the empirical research see Houston and Fletcher, 1940 and McGilvray, J.A. (1994).

receptors. David Williams (2005), professor of medical optics and director of the Center for Visual Science at the Medical College of Wisconsin published the article in Science Daily with the *title Color Perception Is Not in the Eye of the Beholder: It's In the Brain*. The experiment that he made suggests that the experience of color depends more on the functioning of the brain than the visual apparatus.

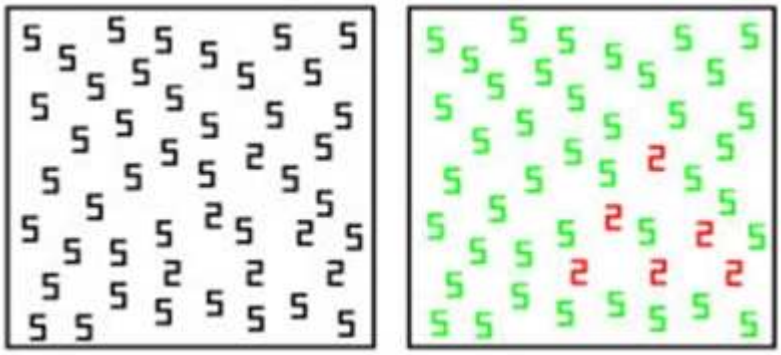
On the basis of a laser system that maps out the topography of the inner eye in exquisite detail[59] Williams and Hofer (2005) had a direct access to the photoreceptive cells in the retina. According to William's latest experiment several people were obliged to wear colored contacts for four hours a day at the time specified. Volunteers tended to report that while they were wearing colored contact lens, they sooner or later felt like they perceived the world normally, or without the colored contacts. In the same way people, when wearing the sunglasses of the specific color tend to see colors 'in the right way' after some time. But, the amazing part that brings Williams a Bressler's Prize in vision science is that when experiment ended volunteers' reported the affect of wearing the contact lens, although they were no longer using them. They experienced the change in the normal color vision that was primarily caused by contacts. Williams states that "this is direct evidence for an internal, automatic calibrator of color perception. These experiments show that color is defined by our experience in the world, and since we all share the same world, we arrive at the same definition of colors" (Williams, 2005).

3.4.2 The case of synaesthesia

According to Matthen color experience is 'physically specifiable', i.e. "it is always possible to describe what a sensory system detects in physical terms" (Matthen, 2007, 199). But this is not always the case. In my opinion synaesthesia presents the important argument against realism about the nature of color. Francis Galton (1880) first made a description of people, with a certain idiosyncrasies; that is, although they are stimulated by one modality, such as musical note F#, in response to it they experience sensations in multiple modalities, that is sound F# and the experience of red color. For instance C# is generally reported as blue. More common is color-grapheme synaesthesia, according to which people experience letters and numbers as colored. For example the number 5 written on the paper 'looks' green, whereas 2 always looks red (see figure 6).

59 A laser system mapping technique is known as adaptive optics, and was originally used by astronomers in telescopes to compensate for the blurring of starlight caused by the atmosphere (Williams, 2005).

Figure 6: Perception of the numbers of non-synaesthetes (on the left) and synaesthetes (on the right).



Source: http://www.lurj.org/article.php/vol2n1/synesthesia.xml

The Figure 6 shows the perception of numbers by normal perceiver on the left and synaesthetes on the right. Since synaesthetes perceive numbers in certain color they easily recognize the shape of triangle on the picture, meanwhile it takes several seconds or even more to see the shape design from the numbers 2 (Ramachandran & Hubbard, 2001). This simple experiment is supposed to show that "synaesthesia is a genuine sensory phenomenon and not a high-level memory association" (Ramachandran, and Hubbard, 2001). Synaesthetes perception of the color associations remains stable through time (Baron-Cohen et al., 1993), although there are inconsistency between synaesthetes, so that one might perceive a certain letter as red, but the other as green (Day, 2001). In addition reports show that it is higher probability that the letter, for instance will be red than green.

Synaesthesia as the argument against Matthen's pluralistic realism is important because it occurs as the consequence of 'cross-wiring' in the brain[60]. The 'cross-activation theory'[61] is the view opposite to the old linear transformation of information from visual organ to the brain. Stimuli are translated into nerve impulses, which travel to the thalamus. The new neurological investigations show that information that is send from thalamus is rather processed concurrently at the different locations of the brain. Moreover these locations in the brain are not autonomous, but evidently they have overlapping functions. This significant

60 In philosophy of mind this is a strong argument against functionalism.

61 The cross-activation is the result of the cross wiring between the 'number grapheme area' in the fusiform gyrus and the 'color area V4' that is also in the fusiform. The method used is fMR brain imaging (Ramachandran and Hubbard, 2003).

consequence shows that the activity of neurons in the sensory (and other areas) in the brain gives rise to the 'qualia'[62]. According to neurologists Ramachandran and Hirstein (1997) qualia depend on the total pattern of neural activity. Color experiences or qualia is therefore correlated with and explained by certain neural properties. Following that there is no systematic correlation between function of the visual systems and paths of neural activity. Therefore colors as such are qualia produced by certain neural activity, when neurons are stimulated by sensory organs. Most importantly it does not matter which ones.

62 Qualia are the 'raw feels' of conscious experience; i.e., the redness of red, the painfulness of pain, and etc. For instance when one imagine the blueberry, her/his consciousness experience has at least two qualia, a quale (sing.) of color that is responsible for the sensation of redness, and a quale of the shape, which is responsible for the square appearance of the blueberry. Qualia give human conscious experience the particular character that it has (Ramachandran, and Hirstein, 1997).

4 The final verdict: color as subjective

The nature of color seems to be divided between two worlds in terms of which theoreticians try to describe it. Physicalism on the one hand tries to explain color on the basis of physical facts about fluctuation of visible light. Subjectivism on the other tries to describe color in terms of psychological experiences that are completely 'anthropocentric' and cannot be explained by quantitative physical facts. In particular, the correlation with external facts, traditionally proposed as the basis of color perception, is tenuous to the point of almost disappearing. Perhaps experiences might be explained by the physical neural activity in the brain, but this too does not correspond and cannot be explained by external physical facts. The distinction can be classified according to the following pairs of contrast: external-internal; quantitative-qualitative; and explanatory-non-explanatory. The question that has been with us in this work seems to be the following: what is real, color as objective or color as subjective, what the distinction is and how can there be the relation between them? I am a subjectivist about color, so let me explain two major subjective positions of color perception: eliminativism and mentalism, the later of which will be my final, unfortunately somewhat sketchy answer: physical objects are not colored and color as such does not exist externally or independently of the perceiver.

Eliminativism, being species of subjectivism, states that objects do not have color, i.e. are merely achromatic. In addition, experience of color can be easily reduced to the processes within our visual apparatus. With regard to the thesis of incompatible components and the problem of metamerism, we should not count the visible part of the electromagnetic spectrum as colored. Rather we should say that it consists of different values, which can be described in its own quantitative language, for instance as having wavelengths of 650 nm, or 735 nm, and so on. I disagree in particular with the type of eliminativism that reduces color experience to the processes in the (extra cranial) visual apparatus, instead of the neural activity. As the case of synaesthesia and different experiments in neurology shows color sensation can be reduced, if at all, only to neural activity in the brain.

According to mentalism color is subjective, internal or individual experience. As such it can be treated as a quale. I agree with mentalism that color experience cannot be explained on the basis of external physical features, such as light or surface structure of the object. However, I believe that it is caused by neural activity in the brain that is as such physical entity. I am

more inclined to mentalist strand of subjectivism, which argues that color is something mental. Whereas according to eliminativism the word 'color' can refer neither to physical nor mental entities in the world, in my opinion it seems to be more plausible to believe that it denotes some mental entity or a quale.

As opposed to objectivism I do not think that subjective color[63] is unreal because it is mind-dependent and reducible to some physical, i.e. neural entities. For instance, one might say that numbers are real, although they are mind-dependent and perhaps irreducible. The term 'real' means that there is, ontologically exists, something in this world (Boghossian, 2002). Moreover, I claim that color is not merely potential or possible disposition of the object, but it is actually there; it exists, whenever it is manifested in virtue of neural activity. Robinson asserts that the "realist has no account within his ontology for non-veridical phenomena", such as hallucinations. They obviously exist independently of the external physical world (Robinson, 1994, 237). So, following his lead, the case of hallucination could be taken as an example of color experience independent of the external world. Although I hallucinate, I still experience the color that can be described as red, green, and yellow and etc. Let me now introduce the argument against dispositionalism that seems to be related to hallucination.

4.1 Rejection of dispositionalism and physicalism

As it is explained in the second chapter, Locke's terminological problems suggested the conclusion that dual dispositionalism is inconsistent. It cannot be the case that color as secondary quality simultaneously depends and does not depends on a perceiver. The first stage of dependency thesis indicates that color as secondary quality is a physical property or disposition of the object, while the second stage of dependency thesis points to a strict dispositionalist version, according to which color is perceiver dependent. The first one will be completely rejected in the next chapter. Therefore, let me focus on the arguments against Lockean version of dispositionalism.

According to Locke, an object is red if and only if it produces the idea of red in us; in other words when it is manifested in our mind as red. It does not matter whether different perceivers experience a given secondary quality in different ways, since each of them is right

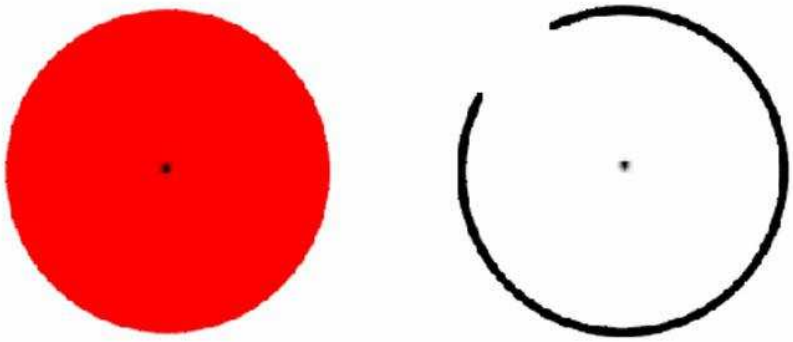
63 The distinction between the experience of color and color as the feature on the object can be best described as subjective color and objective color.

about what he perceives. However, even if they are right about (their respective) color perceptions, dispositionalism does not tell us what the actual color-property of the object is.

The dispositionalists might argue that disposition as such or secondary quality is not explanatory, whereas experience is. In my opinion empirical facts do not show that secondary qualities are not explanatory. Different wavelengths are descriptive in a different language than experiences are. We do not need to say the object has a disposition to be (or appear to be) red, but that it has a specific wavelength that causes such and such experience. But this later view is not without its problems.

Further, Boghossian and Velleman (1989) present the interesting problem of after-images dispositionalism is facing[64]. The negative after-image is caused by overstimulation of photoreceptors. For an example, please look at the figure 7, first at the red object on the left and then the white object on the right.

Figure 7: Afterimage responses



Source: http://www.wellesley.edu/Neuroscience/Faculty_page/Conway/science.htm

Staring at the red colored object produce a green after-image or the opposite color experience, when we look at the white object afterwards. The problem for dispositionalism is that after-images do not seem to be dispositions or something external, but more like "a figment or projection of one's eyes" (Boghossian and Velleman, 1989, 87).

64 Boghossian and Velleman (1989) do not distinguish between negative and positive after-image. In the discussion I will focus merely on the first one, since it is perfectly explained by science.

Although after-image cannot be produced without the person having observed some object, after-image is, after all, the product of his/her brain. The dispositionalist can go on to claim that the same object can produce different colors in the same perceiver. Let me here offer my own rejoinder, independent from Boghossian and Velleman's criticism. In my opinion, if this is true more precise definition should be given. It should include the possibility (made vivid by our Figure 7) that the object on the left has a disposition to produce the experience of green in the object on the right. This would change the official definition of dispositionalism in the following way: an object is red if and only if it produces the idea of red and produces the idea of green when we perceive white object afterwards. This is not always the case, since after-image depends on the saturation of the color we primarily perceive, light conditions and time we perceive it. Besides how can it be the case that the object A produces besides the color experience of A, the color experience of the object B?

This is an unpleasant situation for physicalism as well. According to physicalism object usually emits a certain proportion of wavelengths and therefore should produce a red and not green experience in the observer. Moreover the perception of green causes the after-image that is magenta color. That is due to the fact that after-image is created by the opponent processes in our eyes. Magenta cannot be found in the beam of white light that is made up of all the colors in the spectrum. Therefore color is the product of the brain and it is subjective.

In addition one might raise the question of how the dispositionalists explain the variability of color experience through time in the same perceiver and how it is that different species perceive color in a different way. Do the objects that emit UV light have dispositions to produce color in perceiver or not? Dispositionalist would say that it does in the normal perceiver. But, if this is true, human being is not a normal perceiver, since he cannot perceive the UV light as color. Moreover it is scientific fact that color vision changes in perceiver through time. The older people perceive the world in a slightly more yellow color shade. So, how can it be that the same object has a disposition to produce in the same conditions different color shade in the perceiver? In this case color experience does not change because of some change in the object, but because of the change in visual apparatus of the perceiver that is getting older. So, the color vision does not depend only on the disposition object has to produce a certain experience in us, but also on the structure of our visual apparatus. That shows that color experience depends on the structure of the visual apparatus and moreover it can be the case that is independent of the external physical object. Since I refuse that visual

apparatus has the primary role for the perception of color, color is the final product of neural activity and it is as such mental. In addition, I agree with Hardin (1988) that colors are intrinsic, subjective for each individual that perceive them.

4.2 Colors as qualia

A clear and often quoted example speaking for color as subjective is Hume's example of a missing shade. His example is interesting because it presents subjective colors as related to each other in a different way than it might be observed by the color spectrum of the beam of light.

"Suppose ... a person to have enjoyed his sight for thirty years, and to have become perfectly well acquainted with colours of all kinds, excepting one particular shade of blue ... Let all the different shades of that colour, except that single one, be plac'd before him ... Now ask, whether 'tis possible for him, from his own imagination, to supply this deficiency, and raise up to himself the idea of that particular shade, tho' it had never been conveyed to him by his senses? I believe there are few but will be of opinion that he can; and this may serve as a proof that the simple ideas are not always derived from the correspondent impressions" (Hume, 1965, 4).

Subjective colors stand in complex relations to each other; moreover these relations are constant and do not resemble the physical fact about the objective colors (as the thesis of the component incompatibility shows). This suggests that they are the product of our brain, rather than properties of surfaces of objects. My argumentation for subjectivism follows Larry Hardin (1988), who concludes that objectivism is false since the structure of the spectrum of wavelengths does not corresponds to the structure of the spectrum of the colors as we perceive them. The spectrum of the objective so-called colors, their relations and classifications that we made on the basis of our measurements of the wavelengths do not correspond to the spectrum of subjective colors, their categorization and relations that implement our RGB or trichromatic system.

4.2.1 Qualia introduced

The term "qualia" is nowadays widely used in philosophy and psychology. For instance, for the purpose of distinguishing among different color sensations Ramachandran and Hirstein appeal to qualia in their work *Three laws of qualia: what neurology tells us about the*

biological functions of consciousness (1997). The term is often used in the cases of neurological syndromes in which consciousness seems to malfunction. Ramachandran and Hirstein (1997) put as an example of qualia the experiences linked to temporal lobe epilepsy, visual scotomas, Charles Bonnet syndrome, and synaesthesia (Ramachandran, and Hirstein, 1997). In the work quoted they offer an empirical investigation about 'qualia' rather than a philosophical one. Despite this their work is significant for philosophical discussions about qualia. Ramachandran and Hirstein argue that "qualia are different from other brain states in that they possess *specific* functional characteristics" (ibid. 1997) Qualia are irreversible once experienced, which means that we cannot merely make a decision of seeing apples as blue, and in contrast to non-conscious brain states involved in the regulation of behavior, qualia endure in short-term memory (Ramachandran and Hirstein, 1997). In addition, according to the traditional philosophical approach qualia are ineffable, private, and intrinsic.

The possible existence of qualia is presented by Ramachandran and Hirstein's (1997) thought experiment example; reminding one of the classical Mary thought experiment[65]. Imagine a super-scientist who came from another planet and is by his nature monochromic. He is curious about the phenomenon people call color, and observes that when a normal color perceiver looks at objects, s/he describes them as blue, green, or red, etc. But, for super-scientist everything looks in different shades of gray; that is from black to white. He decides to examine the humans' brain when one perceives an object and names it in a certain color. In his research super-scientist realizes that, when he points at the objects in the presence of light and the object reflects a certain wavelength, individual would prescribe to the object specific shade of color. Still, super-scientist has no idea to what the wavelength correspond when people say 'color'.

Finally, the super-scientist makes the study of the eye, photo-pigment cells, neural events, and the way experience is produced. He concludes that he now completely understands all the laws of color vision. Although he has complete results about color vision, he cannot know how is to feel 'red'. Ramachandran and Hirstein (1997) conclude: "that is the part of the actual experience of the color which it seems we can never convey to super-scientist" (Ramachandran, and Hirstein, 1997). In my opinion their thought example can be developed even further. Here is a puzzle I find interesting. We noticed that the contrast between

65 Jackson's ingenious 'Mary' scenario (see Jackson, 1986).

wavelengths (the longest vs. the shortest in visible range) do not correspond to the contrast in the colors seen. But, the oppositions in the neural channel do correspond roughly to the ones in the colors seen, for instance, red and green correspond to the extreme values of excitation in the same (red-green) neural channel. So, there might exist, after all a neural correlate of the structure of the visible spectrum, a neural structure roughly isomorphic to the qualitative structure of our visual experience. Here an interesting question arises: could our super-scientist at least locate the neural basis of a given missing shade of a given color? Is the neural structure sufficiently fine grained for this task? Suppose, simplifying to the point of caricature, that there are 18 recognizable shades of blue, and that in my experiences the 14^{th} has always be missing. I can imagine it as the one that stands between the 13^{th} and the 15^{th}. But, does the correlate of the 14^{th} stand exactly 'between' the correlate of the 13^{th} and 15^{th}? And in what sense of "between"? Here we should await an answer from neurologist. If it is negative, then our super-scientist cannot explain Hume's missing shade example. Although he can make a specification what wavelength object emit in order to produce in the perceiver a certain shade of color (since visual apparatus of different observer might differ from each other and even change through time) it seems that such specification cannot describe the qualitative character of color experience as such.

In the thought example presented above scientist cannot know what is like to experience red, since he does not have photoreceptors developed for color vision, and the specific neural pattern within the brain is not set up. Silby clearly states that "whenever color is experienced in a normal perceiver, the synaptic weight of the sensory input reactivates the color label in the brain" (Silby, 1998). So, super-scientist cannot know how it is for someone to see colors, since he is missing an appropriate neural processing structure. Despite the fact that qualia have a causal connection to neural activity, I argue for dualism. I believe that qualia are the product of something physical. I do not support the idea of causal closure. Although qualia might be partly and indirectly characterized in terms of neural activity in perceiver's brain, to know what it is like to have the experience of color as such, one has to possess qualia. It is more like to possess knowledge how to, for instance I cannot know how it is to feel to be in love as long I am not in love.

4.3 The nature of color - quale

I believe that color experiences or qualia are intrinsic and categorical, not dispositional nor representational, and posses' only contents such as 'red', 'blue', 'yellow', etc. Although color

experiences have some causal connection to physical properties of the object, they do not convey the information about the features of the external world. Qualia or color experiences serves only to categories and to classify external objects in the specific way for each individual. Color is more likely like pain.

Color, like pain, is not located in the external world, but rather it is a mental entity or something internal. For instance, the experience of red or after-image of green is in our mind in the same way as the headache. Moreover, I prescribe the location to color (or projection of it, if you prefer this metaphor) as it is on the object or in front of my eyes, when I close them, in the same way as I prescribe the location to the headache, which is at the forehead. But, how can it be that color and pain are simultaneously something like experiences and are located somewhere on the objects? One view that seems to describe qualia as having phenomenal and representative character is intentionalism.

The strict definition of intentionalism is: "necessarily, for a single perceiver, and restricted to visual perception, if two experiences of this perceiver differ in their phenomenal character, they differ in their content" (Nickel, 2007). The positive consequence of the intentionalism is that it provides the explanation of perceptual experience. Since we do not ascribe the experience of the red physical object to our awareness, but to the object outside of me, intentionalism avoids this problem by describing qualia in two different ways that is phenomenally and representatively. But, this view is not without problems. Famous thought experiment against intentionalism concerns the possibility of a color-inverted person, who perceives color in the opposite way than normal observer[66].

For instance, Mary and Fred observe a red object. Fred has inverted color spectrum, since he possess two types of red-green color blindness and Mary is a normal perceiver. They both claim that they perceive the red color of the object. It seems that they both discriminate different shades of colors in the same way, and it seems that experiences have the same content, and are therefore about the same thing. Therefore, they should also have the same or similar quale. But, this is not the case, since they have different qualia. Fred observes the object as green and not as red. The quale as such is different, but the content is the same. It follows that it is impossible reduce the phenomenological character of experience to its

66 The example of color inverted perceiver was already presented by Locke.

content. I am aware that this is just the beginning of the long and complex debate, but I hope to indicate the direction in which my argument would be going.

Let me pass to an old problem in philosophy that has been with us since Aristotle's time. If 'red' is real in qualitative sense, then the property of 'being red' has to be ascribed to something that 'is red'. That is similar to the thesis of objectivism, with regard to which objects have properties of being certain shades of color, so it seams a threat to my subjectivism. I propose the following solution to the historical problem of the nature of color. Colors are subjective, more specifically they are qualia or sensation and are caused by the neural activity. I leave it open whether qualia are nearly epiphenomenal or whether they do cause in turn something. More precisely the characterization of perception of color is the following:

Characterization: Colors are sensation or qualia caused by a certain neural activity.

Let me clarify my terminology. *Sensation* as such should be, and in philosophy routinely is, distinguished from perception. Although sensation and perception seem to be terms that can be used interchangeable in everyday language, they are distinct, but complementary processes. According to psychophysics[67] a sensation is the passive route of bringing data from the exterior world into the body and to the brain; meanwhile perception is defined as the active process of picking, systematizing, and understanding the data brought to the brain by the senses. The distinction between passive and active process is made by the necessity of being consciously collaborate in a process. Sensation occurs when sensory organs absorb energy from a distal stimulus in the environment and sensory receptors convert this energy into neural impulses and send them to the brain. From here on follows the perception; i.e., the brain organizes the information and translates it into something meaningful. The brain does that by the selective attention and perceptual expectancy. According to that one distinguish between what is significant and what is beside the point, and is influenced by motivation[68]. With regard to perceptual expectancy the perception of the world is a function of our past experiences (know-how), society, and genetic background[69] (Goldstein, 2002, see also Kuehni, 2005, p. 30).

67 Psychophysics is the study of how physical stimuli are translated into psychological experience.

68 For example - students in the class should focus on what the teachers are saying.

69 E.g., one might look at a painting and not really understand the message the artist is trying to convey. But, if someone tells you about it, you might begin to see things in the painting that you were unable to see before.

In my opinion experiences are not what we see, but by which we see, as Hatfield (2007) nicely claims. According to my view qualia, by which we see do not correspond to anything external at all. They are bare products of the stimulations of our visual apparatus that cause neural activity. Neural activity plays the basic role in producing phenomenal experiences or qualia. An individual perceives the world in her/his own 'solipsistic' (or, to put it less dramatically, idiosyncratic) way, since qualia depend on her/his own structure of visual apparatus, neural activity and specialty of perception. In my opinion phenomenal experiences are real, since the perceiver has the experience that has a qualitative character of red.

Summary and conclusion

Two basic things that I noticed during my study are that philosophers of mind mainly do not use the latest investigations done in the field of neurology and that subjectivism seems to be kept in background. Furthermore the arguments against subjectivism are mainly against the narrow subjectivism, not broader versions that include the physical facts as the causes of sensation. In my opinion, this broad version of subjectivism is worthy of deeper study, since it might present also the solution to the hard question in the philosophy of mind. The idea of different language helps us to cope with the different states, such as physical and mental. But, I think that more strict definition should be given. In addition, definition I propose for the sensation of color, should explain what the relation between qualia and neural activity is.

I have tried to make use of the scientific approach. In the first chapter I present the latest empirical facts discovered in different fields about the color vision, such as physics, physiology and neurology. The empirical research illustrates the problem of color perception from the theories that try to answer the question about the nature of the color and might be overall mistakenly interpreted.

This brings me to the second chapter. Locke, for instance, is in general taken to have been a dispositionalist, but the careful reading shows that he is in fact subjectivist about color. The argument for that can be found in his second stage of dependency thesis, according to which, idea of color has to be manifested in the perceiver in order to exist. Further, the important argument for subjectivism is his description of color as analogous to pain.

The distinction between color and pain presents the very beginning of treating color as qualia, since color and pain are individual-bound, subjective, and as such, independent of physical

world. The distinction between color and pain is only that colors appear to be placed in the external world or as the properties of the physical objects, while pain is located in the body. The denomination is the argument for the support that Locke is subjectivist. Color is primarily denoted as idea and merely in derivative sense as the quality of the object. I conclude that Locke can be read as subjectivist.

In my third chapter, I try to show what kind of properties are colors as subjective and try to refute Matthen's idea of realism and the importance of functioning of the visual apparatus. In order to answer the question whether color is by its nature subjective I investigate Matthen's thesis of realism. As the argument against physicalism I reformulate the well known argument; i.e., the component incompatibility, that was introduced by Hardin. Relations of contrast and similarity that hold between color sensations do not match proximity and distance among wavelengths. For instance, sensation of red is the opposite to the sensation of green, but this does not hold for the physical spectrum of different wavelengths, with regard to which red is opposite to violet and not green. In the thesis other similar examples are presented. This provides a good reason to believe in the error theory. We cannot perceive the brute physical reality in one-to-one relation. So, we are fastening to our sensation of the world as something that is real, although it not only fails to not equip us with all the information in the physical world that we need or would like to have, but often positively misleads us.

In order to provide the explanation of colors as subjective I object to Matthen's commitment to classificatory model of visual apparatus, since it does not have such significance for the philosophy of perception. In my opinion, neural activity in the brain that causes sensations in us plays the primary role. One of the well known arguments for the significant role of neural activity is the brain adaptation, and the case of synaesthesia that seems not to have been discussed in the philosophy in general. Both arguments suggest a considerable role for the explanation of neural activity and sensation of color and moreover they provide the empirical arguments for the existence of qualia. (Also, qualia in this sense play the role of recognition and classification of the external bodies.)

Since the sensation of color is individual-bound, it is subjective. Neural activity is in the same sense unique for each individual; since the path of the neural activation might be different in each individual that senses the specific shade of color. Therefore, I argue for the strongly anthropocentric definition of color (much more seriously anthropocentric than the one

proposed by David Hilbert, who merely relates physical parameters to the human subject, the perceiver). I conclude that *color is the sensation caused by a certain neural activity.* This view allows for the existence of hallucinations, and it agrees with the idea that the color sensation might be caused by different sensory organs. Our brain plays the primary role in sensation and as such subjectivism argues for all kinds of phenomena that are connected to the brain.

The subjectivist view, according to which color is treated as qualia or the product of neural activity has to give the answer to the hard problem in philosophy of mind that is the solution to the mind-body problem and I hope it will succeed one day. I think that the gaps in our understanding of phenomenal properties should not demand a rejection of them, like the need of further research in gravitational attraction should not lead us to reject (the existence of) gravitation. The right way is to keep on investigating and to stay open-minded, since further development in science might subsume the existence of the phenomenal. That is why I think we should accept the phenomenal as something real, either in terms of dualism or of some future explanation of phenomenal in terms of brain activity. As Hatfield puts it, "philosophers should acknowledge the phenomenal as a natural fact, integrating the descriptions of psychologists, or of observationally astute philosophers, into their descriptions of the mental, and situating the domain of the phenomenal within a larger natural, cultural, and philosophical landscape" (Hatfield, 2007).

Glossary

Broad subjectivism - view in philosophy of perception according to which color is subjective property and it is caused by external or physical stimuli.

Color as an idea - Lockean experience of color that is produced by secondary qualities.

Color as secondary quality - Lockean power of the object to produce idea of secondary quality in the normal perceiver under standard conditions.

Distal stimuli - acc. to Matthen, the external objects or features of the objects that stimulate the sensory organs.

Narrow subjectivism - view in the philosophy of perception according to which color is subjective and it is not caused by distal stimuli.

Perception - the active process of picking, systematizing, and understanding the data brought to the brain by the senses.

Sensation - the passive route of bringing data from the exterior world into the body and to the brain.

Visual apparatus – the eye; i.e., human, animal.

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