Wiadomości Zootechniczne, R. LVI (2018), 4: 217–220

Colour Vision in Chickens

Eugeniusz Herbut[1], Zbigniew Dobrzański[2]

[1] National Research Institute of Animal Production, Department of Poultry Breeding, 32-083 Balice near Kraków
[2] Wroclaw University of Environmental and Life Sciences, Department of Environment Hygiene and Animal Welfare, ul. Chełmońskiego 38C, 51-630 Wrocław

Colour vision is crucial for both humans and animals, including birds, and therefore is worth deeper thought. It influences our emotions and behaviour. It is not without reason that we tend to use expressions like "to see the world through rose-coloured spectacle", or "to be green" or "in black despair". We live surrounded by colours. Red is the most effective at enhancing our attention. Blue is the most popular and is essentially soothing. Green is the colour of balance and peace. Yellow and orange are inspiring and stimulating (Honigmann, 1921; Hannah, 2004; Kreft and Kreft, 2007).

Colours are psychological impressions induced in birds' or animals' eyes when the eye is stimulated by electromagnetic radiation in the visible spectrum. In other words, colour is a common name for chroma: colours are divided into chromatic and achromatic, from white, through grey, to black. It is noteworthy that white fully reflects a wide range of the visible wavelengths of light, while black is the result of an absence of reflection or complete absorption of visible light. This impression is largely determined by the wavelength mixture of light radiation and, secondly, by the amount of light energy. However, the presence of other colours in the eye's visual field and the ability to use the sense of sight also contribute to reception of individual colours, an impression mainly determined by the wavelength mixture of light radiation, amount of light energy, presence of other colours in the visual field and individual features (Wojtusiak, 1964; Kovach, 1978; Klynneti al., 2014).

Visible light is only a small portion of the EM spectrum. Infrared and ultraviolet are in some respects treated as light, yet none is detectable by the eye. There are all grounds to think that light not only gets to us, but also penetrates our bodies. Experiments showed that light gets deep through skulls (e.g. in sheep) to stimulate photoelectric cells inside the brain (Kreft and Kreft, 2007). Light is known to affect the sexual cycle. Laying performance in hens is stimulated by light through extending the duration and intensity of lighting.

Our ability to see the world in colour is chiefly due to electromagnetic radiation, with light being only a small portion of that radiation, to which the visual organ responds. In the spectrum of electromagnetic waves, visible radiation represents waves between 380 and 770 nm (Wojtusiak, 1964).

The process of seeing colours is initiated in the retina, but is actually conducted in the brain. The matter is as much person-specific as the culinary or artistic taste. Now, it may be useful to explain how colour perception works. The notion can be defined as the potential of an organism to distinguish objects based on the wavelengths of the light they reflect, emit or transmit. In other words, colour vision is the process of light reflection from the radiated surface. True black is seen when the incident light on a dark surface is perfectly absorbed; all we see then is a dark spot, i.e. black colour. When light falls on bright surfaces, it is reflected in 100%, with all the colours together creating a beam of white light. This is how we see white colour. According to the above, white colour is seen when waves of different frequencies get to the eye and all types of cone cell are equally stimulated (Hannah, 2004). Chickens have been reported to have a much more complex structure of cone photoreceptors. While humans have three types of cone cells sensitive to red, blue and yellow light, chickens have additional cones that respond to violet light and specialised receptors that help them detect motion. The latter are believed to be needed and used by the birds to search for food. Chickens see more colours than humans. They are sensitive to ultraviolet light and see dawn before humans, meaning that they see daylight nearly one hour earlier than we do (Gawęcki, 1975). Chickens recognise up to 100 other flock members. Yet they cannot see in the dark, as they lack nerve cells sensitive to luminous intensity. Out of all senses used by birds, vision is of utmost importance, with the remaining ones being far less developed. Bird eyes are proportionately much larger than human eyes. They take up c.a. 15% of the head weight, compared to slightly more than 1% in humans. Chicks are perfectly aware that an object that disappears from their visual field does not cease to exist, a fact not known, e.g., by one-year-old children (Kovach, 1978).

Visual field studies carried out (Hannah, 2004) on Leghorn and Sussex chickens showed that the birds see maize grains from 4.5 m, a handful of grains from 3.5 m, a handful of maize grains from 6 m and a medium-sized plate from 9 m compared to 40 m for other birds from the same species. The above is related to illumination brightness, colour and form of the feed served (granules, powder).

Birds' response to colours

A critical, yet underestimated issue, is the colour of protective clothing and the importance of not changing it as the poultry gets accustomed to it quickly. Given the above, the employees and visitors at the farm should at all times be wearing clothes of the same colour. Changing the colour of clothing causes unnecessary stress in birds, which shows in their timidy each time the employees enter the room. The birds' agility results in bigger air pollination, and the chicks are afraid to eat and drink water. They are under stress.

For the above reasons, Herbut (1988) conducted an experiment where the colour of protective clothing (white, blue and claret) was examined. In slaughter chicken rearing period, isolated squares (3 x 5 m^2) of the poultryhouse (20 chickens /1m^2) were watched for birds that got timid whenever the employees entered and performed the necessary cleaning and nursing works, and the number of such birds was reported. The square size (5m^2) selection was determined by the possibility to closely monitor the area and the stock (20 chicks per 1m^2, i.e. 100 birds in total). Therefore, the number of frightened birds was always referred to 100.

Although studies on coloured vision in diurnal birds have been conducted for several dozen years, a number of important notions concerning the subject have remained unknown. These include, among other things, the role of colour contrast in chicks. As stated by Honigmann (1921), colour vision in chickens covers the range from 400 to 715 millimicrons, which means that they see all colours, from violet to red. Mature chickens have intensely red oily drops in their eyes, more sensitive to long-wave and less sensitive to short-wave colours than human eyes. Wojtusiak (1964) emphasises that domestic chicks' oily drops (located in cones, i.e. cells in the retina responsible for colour vision) have less intense colouring than those of adult chickens, which is why their colour recognition ability is more similar to the human sense of vision. This clarification is important in so far as we tend to explain domestic chicks' sense of colour by comparing it to ours. It is worth noting that despite the analogies between colour vision in birds and in men, birds only differentiate between c.a. 20 colours, compared to 160 colours distinguished by humans. As already mentioned, colour plays a very important role for poultry, as it helps the birds identify different objects (Gawęcki, 1975).

Sobczak (2013) conducted observations connected with the selection of nests painted white, yellow, red, blue and green by chickens. Her research showed that chickens preferred grayscale nests, i.e. green and blue, while white and yellow ones were chosen with utmost reluctance. This leads to a conclusion that birds prefer nests with realistic nature-like colours. Similar observations had been previously made by Hurnik (1973).

Quail egg lighting with white and infrared light significantly reduced the number of dead embryos and of unhatched, crippled and faint nestlings (Gwara, 2004). Material impact of the aforementioned light on the final effect of incubation (i.e. obtaining healthy nestlings) was also reported. When both lights were used (with and without the infrared) in the hatching period, the quail nestlings hatched out 2 days earlier and manifested better growth, lower forage consumption and better survival rate in the rearing period compared to those hatched in darkness.

A study testing the reaction of birds to white, blue and claret protective clothing did not prove unambiguously that, despite the varying timidity, the birds did differentiate between the colours (Herbut, 1998). The phenomenon can be interpreted as follows. The luminous intensity was the same in all experimental rooms (5 lx). What differed, however, was the average luminous intensity of light reflected against the protective clothing, which equalled 5.8 lx, 4.6 lx and 3.9 lx for white, blue and claret clothes respectively. White protective clothing, near which the highest reflected light intensity was reported, was probably seen by birds as the most prominent (or bright), and therefore caused the most intense reaction. Claret clothes were the least contrasting and, consequently, the least visible. White, blue and claret colours are within the chickens' visible range (violet to red). Intensity of the light reflected from individual clothing colours shows that claret was less visible than white and was not so contrasting to the birds as white. As a result, broiler chickens were not so frightened when seeing it. Therefore, Herbut (1988) noticed that the colour of protective clothing had an indirect impact on the production performance of broiler chickens. The growing timidity of birds was accompanied by a statistically bigger consumption of forage per 1 kg of body weight gain in the poultryhouse where the staff wore white protective clothes than in the one with claret clothing. Similarly, the number of dead birds was bigger in the group with white clothing.

Every bird best distinguishes those colours that bring biological benefits – they enable finding a partner, find food or facilitate spatial orientation. In practice, the colour of forage stimulates consumption, facilitates cognitive behaviorism that contributes to pecking order stability and may have a calming effect on the birds (as the claret protective clothes described above).
eed purity and kept extensively in dehesa, a floristically unique pasture system in Europe.

Literature

Gawęcki W. (1975). Widzenie barw i ich rola w chowie i hodowli kur. Biul. Inf. COBRD, 1: 15–18.

Gwara T. (2004). Oddziaływanie światła na wylęgi jaj przepiórczych i parametry wychowu wylężonych piskląt. Zesz. Nauk. AR we Wrocławiu, Zootechnika, LII, 505: 88–89.

Hannah E. (2004). Colour constancy in context: roles for local adaptation and levels of reference. J. Vision, 4 (9): 693–710.

Herbut E. (1988). Reakcja kurcząt brojlerów na barwę odzieży ochronnej. Rocz. Nauk. Zoot., 15, 1: 207–214.

Honigmann W. (1921). Untersuchungen über Lichtempfindlichkeit und Adaptierung des Vogelsages. Pflüg. Arch. ges. Physiol., ss. 1–72.

Hurnik J., Reinhart B.S., Hurnik G.I. (1973). The effect of coloured nests the frequency floor eggs. Poultry Sci., 52, 1: 389–391.

Klynn C., Smith L., Zieliński S.L. (2014). Mądry ptak. Świat Nauki, 4: 89–93.

Kovach J.K. (1978). Colour preferences in quail chicks: Generalization of the effects genetic selection. Behaviour, 65: 263–269.

Kreft S., Kreft M. (2007). Physicochemical and physiological basis of dichromatic colour. Naturwissenschaften, 94: 935–939.

Sobczak J. (2013). Badanie czynników decydujących o wyborze gniazd przez kury nieśne. Rocz. Nauk. PTZ, 9, 2: 73–82.

Wojtusiak R. (1964). Zmysł barw u zwierząt. Prz. Zool., 8, 3: 201–221.

COLOUR VISION IN CHICKENS

Summary

Colour vision is crucial for poultry. Every bird best distinguishes those colours that bring biological benefits – they enable finding a partner, find food, or facilitate spatial orientation. The colour of protective clothing worn by poultryhouse staff is not without significance in the day-to-day handling of birds. A study testing the reaction of birds to white, blue and claret protective clothing showed that the birds feared the white colour most, followed by blue and claret colours. This had an indirect effect on feed conversion and chicken mortality.

Key words: birds, colour vision, protective clothing colour

Fot.: M. Pasternak, J. Calik