ISO SPEED AS THE TECHNICAL AND CREATIVE ELEMENT OF THE DIGITAL PORTRAIT PHOTOGRAPHS

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Abstract: System of digital portrait photography from the viewpoint of influence of changes in ISO speed to colour and general impression of portrait photography is analysed. ISO speed is pointed out as one of the technical and creative elements of digitally captured portrait photography. Munsel ColorChecker and the real portrait were shot with the appropriate white balance, and exposure with ISO speeds of 100/21, 400/27 and 3200/36, edited with rendering with perceptual intents and analysed through L, a, b values, ΔE_{00} , CIE ab diagrams and visual estimation. It is concluded that the digital photography system allows selection of higher ISO speeds than classical photography systems with no real impact on the perception of portrait photography. This allows working with lower lights and lenses speed. Nevertheless, this feature of digital shooting creates certain limitations in the working with available light.

Key words: portrait photography, digital photography, ISO speed, skin colours, colour difference

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1. Introduction

From the very beginnings of photography in mid-19th century until today, people are the most common motif on the photograph. In its first hundred years photographic technology has advanced so that it enabled the creation of identifiable photographic syntax and semantics, and the photography is levied as the dominant portrait technique (Hurter, 2005). At the end of the twentieth century in the photographic practice new system appeared - the system of digital photography. Although in the first time system of digital photography was not concurrent, with its technical development in the nineties of the 20th century it begins to intrude into the professional photography and today is the most used photographic system in all areas of amateur and professional photography, as well as in art photography. Following the technological development digital photography retains all the basic properties of the photography as a medium and photographic semantics and syntax that were created through the 'classical' photographic systems are valid no matter in which techniques the individual phase is realized. (Mikota et al., 2006). The basis of good portrait photography is in the shooting - in this phase of each photographic system photographer defines the basic characteristics of a photograph using the technical possibilities of the photographic camera and other equipment in order to express his thoughts and feelings and, with portrait photography, show the model as he sees and experiences it at the moment. Therefore, the modern photographic cameras are built in a way that photographer feels as small as possible difference between classical and digital technology. (Mikota et al., 2006). In this paper, based on the measurement and visual analysis, the influence of ISO speed on the technical and creative characteristics of digitally taken portrait photographs is examined. The influence of ISO speed on skin and primer colours on the portrait photograph, as well as parallels with the influence of ISO speed changing in "classical" portrait photography, is analyzed.

2. Theoretical part

One of the basic technical elements of creation by photography is the selection of the ISO speed. With selecting the ISO speed in the portrait photography photographer does not only define the flexibility of film (in the 'classic' photograph) i.e. the sensor (in digital photography) to lighting conditions, but defines impression characteristics of the photographs (London et al., 2007). One of the specifics of the shooting with digital photographic camera is the possibility of choosing the ISO speed for each photograph. With this possibility photographer, in fact, significantly expands the choice of exposure selection and, assuming the same lighting and same exposure time, with increasing ISO speed photographer can shoot with a smaller lens aperture, or with reducing the ISO speed with larger lens aperture (Schnelle-Schneyder, 2003). In this way, in the portrait photography, the ISO speed, indirectly, becomes the regulator of field depth, but it also provides selection of optimal exposure time (1 / 60 s or less - depending upon the used lenses, but also the possible movements of model) in most of portraitmaking light conditions. With this logic of selecting the ISO speed, photographer expects not to significantly affect other

elements of photographic image, and in portrait photographs mainly on the reproduction of skin colours (Nelson, 2007). On the other hand, the increased ISO speed enters the field of working with available light - in art portrait photography especially appreciated aspect of portrait photography, which allows the transfer of atmosphere without the use of additional 'imposed' photographic lighting (Langford, 1989). In technical terms, such portrait photography is recognized by increasing structure of photograph which in this area is not considered as an error, but the creative basis for such photographs and from the digital photography system is expected that in this regard can 'simulate' systems of 'classic' photography. Today, the ISO speed is by the standard expressed as the ISO value, which, in fact, states two most famous expressions of sensitivity values - ASA and DIN. Sensitivity of 12 DIN matches sensitivity of 12 ASA (in the ISO system, this is indicated as 12/12 - ASA value / DIN value or abbreviated 12 - the value of ASA). Double value of the sensitivity expressed in the ASA units is gained by multiplying the previous value by 2, and in the DIN values by adding 3 to the previous value (Ang, 2003). ISO speeds up to ISO 100/21 are considered low-sensitivity - photographs taken with such sensitivities are characterized by subtlety in the reproduction of details, but needs work in good lighting conditions; the sensitivities of ISO 100/21 and 200/24 are called medium ISO speeds, and are the most used in portrait photography and they also need good lighting conditions, while the ISO speed of ISO 400/27 and above are considered high-sensitivities, and enable the shooting in low light conditions, but with the loss of resolution details and highlighting structures of the image. In the portrait photography the ISO speed of ISO 400/27 are frequent in the area of reportage portrait photographs with good lighting conditions because they enable working with shorter exposure times and small lens aperture, i.e., freezing of movement with increased field of depth, and ISO speeds greater than ISO 800/30 are included in the area of working with available light (Mikota, 2000; Lerski, 1982). As a choice of ISO speed is one of the basic elements of photographic technique and creation in front of the professional photographic cameras are put demands to have the wider range of selection of ISO speeds. In 'classical' photographic systems, the ISO speed depends on the choice of the film and the ways of developing and the TTL light meter system should be aligned with the defined ISO speed for all photographs taken with one film while at the digital photographic cameras photographer can select ISO speed and sets the TTL light meter system on that value for each photograph (Mikota, 2000). Digital photographic cameras have somewhat narrowed range of ISO speeds in relation to the range of ISO speeds that can be achieved in the 'classic' photography systems (Mikota et al., 2006). The range of ISO speed in digital photography is about ISO 50/18 to ISO 3200/36, while the classical photography uses materials of ISO speeds from ISO 6 / 9 to ISO 12800/42.

3. Experimental part

For the measurement analysis of colour and tone changes in the digital portrait photography system standard colour table - Munsell Color X-Rite ColorChecker - was shot. For shooting the leica format digital camera Canon EOS 5D with the Canon

EF 70-300 mm F4-5, 6 IS USM lens was used, and the colour table was shot in RAW format with the resolution of 12.7 MP. For lighting Canon flash Speedlite 430 with guiding number 43 and light temperature 6000 K was used. Temperature of light source was proved with the system for adjusting the white balance of photographic camera (with a precision setting of 100 K). Lighting was set from the direction of the photographic camera, and the light was measured with the TTL system of photographic camera by segmental light measuring on the standard colour of dark and light skin, taking into consideration the other colours with over all integral light measuring. Photographs were taken with the ISO speed of ISO 100/21, ISO 400/27 and ISO 3200/36. For shooting exposure elements: 5.6 lens aperture and exposure time of 1 / 60 s (for ISO 100/21); the lens aperture 5.6 and exposure time of 1 / 250 s (for ISO 400/27) and the 5.6 lens aperture and exposure time of 1 / 2000 s (for ISO 3200/36) were determined.

In the same conditions, with the same lighting and the shooting settings realistic portrait was shot. All photographs were uploaded to computer by CF memory card reader and than preedited in Digital Photo Professional programme which enables their opening and further editing in Adobe Photoshop CS3 programme.

Editing of all uploaded colour photographs included redefining the colour space, i.e., photographs taken in Adobe RGB colour space were "transported" in the sRGB colour space by rendering with perceptual intent and with Adobe (ACE) colour "calculator" (Sheppard, 2007; Mueller, 2007).

All photographs were defined by the colour depth of 8 bits per channel (24-bit for colour photographs) and prepared in 13x18 cm size in the finest JPG format in 300 dpi resolution.

Shot and edited photographs of colour table were rated by measuring estimation. For shot (Adobe RGB) and edited (sRGB) colour photographs of the colour table L, a and b values for standard skin colours and primary colours of additive and subtractive by using Adobe Photoshop CS3 programme were determined. According to the measured values colour differences (ΔE_{00}) were determined (Luo et al., 2001) for: object (standard colour table) - the shot photograph, shot photographs – edited photographs, object (standard colour table) - edited photographs and CIE ab chromaticity diagrams were made.

For visual estimation of the photographs expertise of photographers who use both the "classic" and a digital photographic system was used. In the estimates, with standard conditions, 20 experts who estimated used sensitivity when shooting on the basis of the expected effect in the classic photographic systems were involved.

4. Results

In Tables 1, 2 and 3 L, a and b colour values through different phases of the photographic system and the colour differences (ΔE_{00}) in relation to the standard, i.e. object are shown.

In the Table 4 colour differences (ΔE_{00}) of shot and edited photographs are shown.

Colour	Phase	L	a	b	ΔE_{00} standard
Dark skin (DS)	standard	37,99	13,56	14,06	0
	shot	38,00	13,00	14,00	0,4476
	edited	38,00	14,00	15,00	0,5897
Light skin (LS)	standard	66,71	18,13	17,81	0
	shot	66,00	17,00	13,00	3,0081
	edited	68,00	17,00	12,00	4,1311
Cyan (C)	standard	51,04	-28,63	-28,64	0
	shot	51,00	-27,00	-35,00	2,9827
	edited	52,00	-20,00	-33,00	5,1136
Magenta (M)	standard	51,94	49,99	-14,57	0
	shot	60,00	50,00	-14,00	7,5306
	edited	60,00	50,00	-14,00	7,5306
Yellow (Y)	standard	81,73	4,04	79,82	0
	shot	87,00	3,00	72,00	3,9332
	edited	88,00	4,00	72,00	4,4942
Red (R)	standard	42,10	53,38	28,19	0
	shot	51,00	54,00	30,00	8,6659
	edited	52,00	53,00	31,00	9,7847
Green (G)	standard	55,26	-38,34	31,37	0
	shot	64,00	-39,00	32,00	7,7318
	edited	63,00	-38,00	30,00	6,9133
Blue (B)	standard	28,78	14,18	-50,30	0
	shot	24,00	22,00	-63,00	4,4594
	edited	25,00	21,00	-62,00	3,7603

Tab. 1. L, a, b colour values and the colour differences (ΔE_{00}) for ISO speed 100/21

Colour	Phase	L	a	b	ΔE_{00} standard
Dark skin (DS)	standard	37,99	13,56	14,06	0
	shot	38,00	14,00	15,00	0,5897
	edited	38,00	14,00	16,00	1,2156
Light skin (LS)	standard	66,71	18,13	17,81	0
	shot	68,00	18,00	13,00	3,7224
	edited	67,00	17,00	13,00	3,1748
Cyan (C)	standard	51,04	-28,63	-28,64	0
	shot	52,00	-26,00	-33,00	2,7070
	edited	51,00	-20,00	-33,00	5,0238
Magenta (M)	standard	51,94	49,99	-14,57	0
	shot	58,00	50,00	-12,00	5,8685
	edited	60,00	51,00	-13,00	7,5741
Yellow (Y)	standard	81,73	4,04	79,82	0
	shot	86,00	2,00	79,00	3,0743
	edited	86,00	4,00	76,00	2,9627
Red (R)	standard	42,10	53,38	28,19	0
	shot	52,00	56,00	31,00	9,7356
	edited	52,00	54,00	31,00	9,7547
Green (G)	standard	55,26	-38,34	31,37	0
	shot	63,00	-36,00	30,00	6,9465
	edited	63,00	-38,00	31,00	6,8932
Blue (B)	standard	28,78	14,18	-50,30	0
	shot	24,00	21,00	-63,00	4,4666
	edited	24,00	22,00	-59,00	4,3644

Tab. 2. L, a, b colour values the colour differences (ΔE_{00}) for ISO speed 400/27

Colour	Phase	L	a	b	ΔE_{00} standard
Dark skin (DS)	standard	37,99	13,56	14,06	0
	shot	38,00	13,00	14,00	0,4476
	edited	39,00	13,00	14,00	0,8735
Light skin (LS)	standard	66,71	18,13	17,81	0
	shot	64,00	18,00	15,00	2,3234
	edited	65,00	18,00	15,00	1,9362
Cyan (C)	standard	51,04	-28,63	-28,64	0
	shot	50,00	-28,00	-33,00	2,2253
	edited	51,00	-20,00	-31,00	4,5799
Magenta (M)	standard	51,94	49,99	-14,57	0
	shot	56,00	51,00	-13,00	4,0024
	edited	54,00	50,00	-13,00	2,1421
Yellow (Y)	standard	81,73	4,04	79,82	0
	shot	84,00	5,00	83,00	1,7327
	edited	84,00	4,00	79,82	1,5452
Red (R)	standard	42,10	53,38	28,19	0
	shot	50,00	53,00	39,00	9,4135
	edited	46,00	54,00	30,00	3,7322
Green (G)	standard	55,26	-38,34	31,37	0
	shot	61,00	-37,00	31,00	5,2079
	edited	57,00	-37,00	32,00	1,7618
Blue (B)	standard	28,78	14,18	-50,30	0
	shot	24,00	17,00	-58,00	4,0706
	edited	22,00	20,00	-56,00	5,3645

Tab. 3. L, a, b colour values and the colour differences (ΔE_{00}) for ISO speed 3200/36

	100/21 ISO	400/27 ISO	3200/36 ISO
DS	0,8105	0,6826	0,8615
LS	1,7529	1,0590	0,8279
C	3,3462	3,0729	3,7817
M	0,0000	1,8528	1,9197
Y	0,8822	1,4020	0,6726
R	1,2662	0,7163	6,1921
G	1,1455	0,7352	3,5945
B	0,7974	2,3705	3,1494

Tab. 4. Colour differences (ΔE_{00}) of shot and edited photographs

Figures 1, 2 and 3 show CIE Lab chromaticity diagrams for standard (object), recorded and edited photographs.

Fig. 1. CIE Lab chromaticity diagram for ISO speed 100/21

Fig. 2. CIE Lab chromaticity diagram for ISO speed 400/27

Fig. 3. CIE Lab chromaticity diagram for ISO speed 3200/36

Table 5 shows the actually used and by experts estimated ISO speeds.

Real ISO speed Estimated ISO speed	ISO 100/21	ISO 400/27	ISO 3200/36
50/18 – 200/24 ISO	20	8	0
200/24 – 400/27 ISO	0	12	0
400/27 – 800/30 ISO	0	0	8
800/30 – 1600/33 ISO	0	0	12
1600/33 ISO or higher	0	0	0

Tab. 5. Used and by experts estimated ISO speeds

5. Discussion

In general, average colour difference (ΔE_{00} – Tables 1, 2 and 3) for the dark skin, which results from the phase of shooting with the flash lighting is 0.49497, and for the light skin is 3.01797 which is within the limits of acceptability for the colours that are directly compared (Knesaurek & Brozovic, 2005). Among the chromatic colours (primary colours of additive and subtractive synthesis – Tables 1, 2 and 3), the greatest colour difference is in the red (average colour difference is $\Delta E_{00} = 9.27167$), and green (medium colour difference $\Delta E_{00} = 6.628733$), primarily due to increased brightness, while the colour differences of other chromatic colours are inside the borders of acceptability, even with direct comparison ($\Delta E_{00} = 6$).

Chromaticity (the tone and the saturation) changed the most in the blue area (chromaticity diagrams – Figures 1, 2, 3) where there has been a noticeable increase of saturation in recorded photographs in relation to the object (standard).

It is also obvious that, for the dark skin colour, for all the ISO speeds, with shooting and editing came to the small change of chromaticity, while the changes are slightly higher for the light skin colour (Tables 1, 2, 3 and 4). Changes that occur with editing of portrait photographs are however higher for some primary colours of additive and subtractive synthesis (Table 4), especially at high ISO speed (most for the C, R, G and B at photographs taken with ISO 3200/36 and what is highest for R where is the colour difference between shot and edited photographs higher from the border acceptability ($\Delta E_{00} = 6$). This can be primarily attributed to the rendering with perceptual intent. Also, colour change of these colours impact on the perception of portrait photography less than changes in skin colours.

Estimation of the ISO speed with which portrait was shot (Table 5) shows that the photographers-experts portraits taken with ISO 400/27 and ISO 3200/36 generally evaluated as photographs taken with lower sensitivity, which is especially expressed in portraits taken with the ISO speed of ISO 3200/36 (not a single photographer-expert did not estimate that portraits were shot with the sensitivity of ISO 1600/33 or more). Such estimates of used ISO speed show that digital photographic system allows the use of somewhat higher ISO speed when shooting without stressing the structure of the image, which in portrait photography allows working with lower power lighting, which is, in general, more comfortable for the model.

However, the unstressed structure of the image when using high ISO speed (e.g. ISO 3200/36) can be a lack to photographic syntax, especially in techniques of working with available light, which is common in portrait photography, at which the image structure (grain) is one of the recognizable characteristics that is used in photographic expression.

6. Conclusions

Changes in the ISO speed when shooting in digital portrait photography affect less the properties of the taken portrait photographs, then when a classic photographic system is used. This allows the photographer to use a higher ISO speed when shooting with digital photographic camera, which allows work with lower lighting (by which the model feels more naturally) and, possibly, the use of lenses with the smaller lens speed.

According to the sensation of the portrait photography, a photographer can choose double greater ISO speed than those that would be elected to work with film, and not to expect the perception of increasing the structure of the image which expands the selection of optimal combination of lens aperture and exposure time.

However, this feature of digital shooting creates a limitations in the creative work with available light, which, in a part, can be compensated with the simulating the photographic grain in the digital photographic laboratory.

Further testing will be focused on the impact of the choice of ISO speed on the portrait photography shot by the other, for portrait photography the most common,

types of lighting as well as on the optimization of compression, resolution and ISO speed in the field of portrait photography.

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