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CREATING A COMPOSITE PORTRAIT: COMPARISON OF TWO METHODS

Introduction. *A valuable source of anthropological information is the so-called composite portrait, which creates an idea of the «average» type of a particular population group. A composite portrait is a kind of cognitive tool that allows the visualization of the integral morphological characteristics of the variability of the face and elements of appearance. This article is devoted to a comparative analysis of two methods of creating composite photographic portraits.*

Materials and methods. *The material for the study was photographs of Santal women (N=64), from which composite portraits were generated in two different ways: 1) using two fixed points in Adobe Photoshop; 2) by three points in the faceONface computer program, developed specifically for creating generalized portraits.*

Results and discussion*. In a composite photograph obtained by the classical method of F. Galton by combining photographs at two pupillary points, the upper half of the face is recorded more clearly in the eye area, but the lower tier of the face remains fuzzy and blurry. When using the third, oral point, we get a clearer picture in the mouth area without losing clarity in the eye area. At the same time, constructing a composite portrait using two fixed points creates an image that reflects the entire range of variability in facial height in the population, and when using three points, facial height is averaged.*

Conclusion. *Unlike a composite portrait obtained by the classical method, combining photographs at three points gives a more attractive image, but at the same time we lose the opportunity to capture the large range of variability in facial height. However, both portrait fusion methods create a developed model that can be used by researchers, museum staff, forensic scientists among others.*

Keywords: *biological anthropology; composite portrait; Santal; faceONface; Galton*

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Introduction

In the late 1870s, Francis Galton, the statistician and inventor of eugenics, began a series of scientific photographic experiments in what he called «composite portraiture». He did so by layering the individual portraits of a given number of people onto a single photographic plate, through a process of partial exposure of each image. The main aim of his work was to create a «recognizable criminal type» as well as an averaged portrait of the sick, among some others [Galton, 1879a, 1879b]. Although Galton is still recognized for his contribution to statistics, composite portraiture had almost no uptake amongst other scientists or even anthropometricians at that time, with the notable exception of Galton's lifelong collaborator, Karl Pearson, as well as a small number of American eugenicists in the 1920s. It is indispensable to name Efim M. Chepurkovsky, who was one of the firsts in the 20th century to implement the method of composite portraits in physical anthropology. Nowadays, especially with the development of graphic technologies, composite portraits are used for a variety of studies in different anthropological areas. For example, a large study of *The Face Research Lab* of the University of Glasgow created averaged portraits from

woman all around the globe, but the authors did not disclose the source of the photos that went into each portrait nor how many images each composite resulted from, but they do provide the software used and allow the general public to try it as well (Available at: https://petapixel.com/2011/02/11/average-faces-of-women-in-40-countries/. Accessed 23.05.2024). Although, because of the abovementioned, these images cannot be used in ethnological studies, they do provide a general image of different ethnicities. Composite portraits are actively used in different biopsychological studies, especially those dedicated to human beauty (for example: [Butovskaya et al., 2014; Krejza et al., 2021]). Among Russian anthropologists composite portraits have been actively used since the 1960s to represent people living in different regions and of various anthropological types [Maurer, Perevozchikov, 2002; Perevozchikov, Maurer, 2009; Perevozchikov et al., 2015]. While working on the creation of composite portraits, different experiments were made, making it possible to connect the technical process of creation (number of samples, the mechanism of the accumulation of separate images on the photosensitive layer and others) with the scientific estimation of the generalized image. It must be emphasized that it is indispensable to use a populational approach to photo selection, as well as to follow the recommendation of anthropological photography.

Materials and methods

We used the materials, result of the work of the Russian-Indian anthropological expedition in 2018 [Bandopadhyay et al., 2018], organized by the Paleoethnology Research Center (Russia), the K.A. Timiryazev State Biological Museum (Russia) and the Department of Anthropology of the University of Calcutta (Republic of India). This is a sample of 214 Santals of West Bengal living in the village Pearson Pally (near Bolpur). The composite portraits are the result of the processing of anthropological photographic data, carried out in the field by Yu.A. Alekseev. Photographic fixation was carried out according to the generally accepted methodology in the Frankfurt horizontal in three main projections (front, three-quarters and profile) with a millimeter scale that allows to scale images and take measurements from a photograph. Also, additional angles refinements, proposed by A.M. Maurer, were involved: full face with closed eyes and shooting of the face with the head thrown back.

Based on the obtained photographic material from the Russian-Indian anthropological expedition, composite portraits were compiled by A.Kh. Chirkova using a special program faceONface, which currently allows to obtain digital photo generalizations of increased clarity by overlaying and comparing images at three points: two pupillary (pupillion) and oral (stomion) (fig. 1) [Maurer et al., 2014; Maurer, Syroezhkin, 2015]. For clarity, in figure 1 we can see examples of composite portraits of Santals created in this program. Composite photo portraits of Santal people in all three projections have been previously published [Bandopadhyay et al., 2018; Russian-Indian Anthropological …, 2022].

In this research composite photo portraits were obtained using two methodologies. A.A. Castro Stepanova created the portraits using a raster graphics editor, while A.Kh. Chirkova used the special computer program faceONface. From the collected material we used 64 separate photos of Santal women. The age range of individual portraits is 18–75 years old; the average age is 37 years old.

The algorithm of creating portraits using a graphic editor (for example, Photoshop, GIMP, Krita) is an analogy of Galton's method, superimposing one photograph into another in a way that the pupils are aligned. The first layer is set to 100% opacity, and subsequent layers are layered at 50%, 33%, 25%, and 20% opacity [Belikov et al., 2014]. The resulting generalized image combines five individual portraits and can be further used as a separate portrait, which can be combined with the same generalized images (fig. 2).

It has to be noted, that when we create a composite portrait of only 5 people, we can see that in some of them the features of different persons do not align. Because we superimpose the images by the pupils, the area of the eyes remains relatively clear, while the area of the nose and the mouth can be extremely blurry. Nonetheless, some of these preliminary images are more or less clear in all areas. This occurs when the face height of the people, used in this specific composite portrait, is similar. Still, when we superimpose a few 5-person portraits on each other, we get a clearer, averaged, picture.

The program faceONface was developed for the optimization of creating composite portraits according to F. Galton by means of new digital images (authors-developers – A.B. Savinetsky and G.V. Syroezhkin).

Figure 1. Examples of the composite photographic portraits created in the faceONface program: Santal males (N=37, average age – 27 years) and Santal women (N=64, average age – 37 years)
Рисунок 1. Пример обобщенных фотопортретов, созданных в программе faceONface: мужчины-санталы (N=37, средний возраст – 27 лет) и женщины-санталки (N=64, средний возраст – 37 лет)

The algorithm of creating portraits using this program consists of the following:

first, the average interpupillary distance for the entire sample (in pixels) is calculated,

then all of the individual images are resized (reduced or increased, respectively) to find the average interpupillary distance and simultaneously stretch or shorten in height, reaching the average distance between an oral point and a horizontal line passing through the pupils.

These transformed images are sequentially superimposed on each other.

The color of a pixel at each point is the average of all pixels that are in a certain point from all the images used. The sequence of the overlay does not affect the final image. It has to be noted that while using the program faceONface the researcher has to only indicate the position of the fixed points (pupils and stomion), and everything else is done by the program automatically.

Results and discussion

As a result, we created composite portraits using the same photographs, but with two different methodologies – employing two and three fixed points. As expected, in the composite photo portrait obtained by the classical Galton pupil alignment method, elements of the eye region are reflected more or less clearly, but the lower tier of the face is indistinct, the dispersion of features of this area is obvious. When choosing the third point, we get a clearer picture in the mouth region, without losing clarity in the eye region (fig. 3 a, b). Nonetheless, when comparing the two portraits side by side (fig. 3 c), we can see that the images are relatively similar and it is clear that they depict the same population.

Overall, we can denote the following main differences in the methodologies, regarding the process of creation of composite portraits and their results.

The methodology with 2 fixed points uses the «classical» Galton's method, while using 3 fixed points is a sort of modification, that was not available in the 19th century.

Figure 2. Illustration of an algorithm for creating a composite portrait using Adobe Photoshop, which is an analogue of F. Galton's method
Рисунок 2. Иллюстрация алгоритма создания обобщенного портрета с помощью программы Adobe Photoshop, аналогичный методу Ф. Гальтона

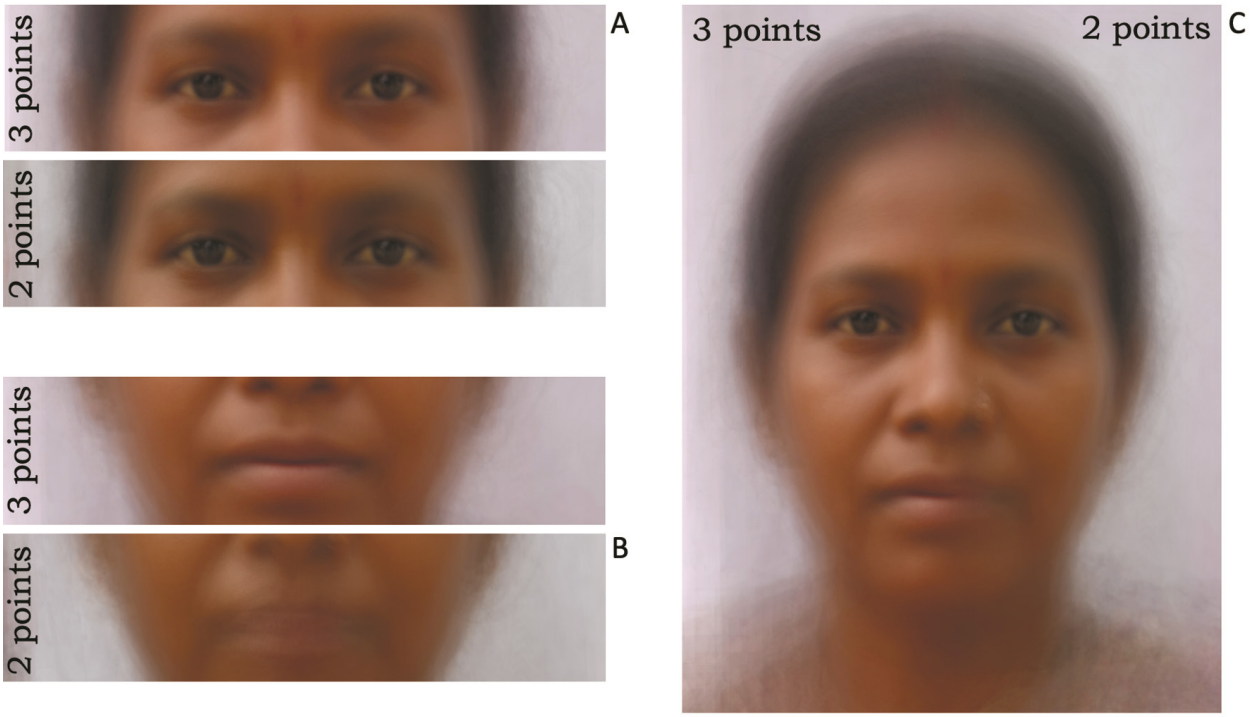

Figure 3. Comparison of two methods for creating a composite portrait using two and three points: combined of the upper (a) and the lower (b) parts of the face; comparing the results of facial generalization in two ways (c)
Рисунок 3. Сравнение двух методов создания обобщенного портрета путем совмещения по двум и трем точкам: обобщение верхней (a) и нижней (b) частей лица; сопоставление результатов обобщения лица двумя способами (c)

The 2-point method does not require any special program and can be done in any graphic editor. Although a 3-point portrait can be created in a graphic editor as well, this procedure would be quite arduous and using a specialized program, such as faceONface, is recommended.

Creating a composite portrait in a graphic editor can take up to 2,5 hours (for the superimposition of 50 photographs), while creating one in faceONface takes around 30 minutes. The first method requires a lot of manual manipulations, while in the 3-point method they are minimal.

Using 2 fixed points creates an image that shows the whole face height variation within the population, while when using 3 fixed points the face height is averaged.

So, in composite photographic portraits obtained using the classical Galton method, in which photographs are aligned and generalized based on the pupils, the elements of the eye area are clearer, unlike the lower tier of the face. By combining photographs using the third point, we get a clearer picture in the mouth area, but at the same time we lose the opportunity to capture the scope of variability in facial height. At first it seemed that with the second method of composite photographs there was a transition from a population approach of research to a typological one. In fact, we observe such a picture regardless of the particular method of generalization we obtain the portrait with. Since, according to the technique of execution, the construction of a composite portrait belongs to the population method, which always subsequently leads to a typological picture in the essential sense. Thus, the method of composite photographic portrait eliminates the contradiction between population and typological concepts, since it finds a place for both approaches in the description of biological variability [Perevozchikov, Maurer, 2009; Maurer 2006, pp. 19–20]. And thus, the method of a composite portrait remains one of the most adequate and objective methods for describing anthropological types [Maurer, 2021, pp. 12–13].

Conclusion

A composite photograph objectively reflects population morphological features of a face and represents not only an integral image of a sample of individuals from a population, ethnic group or target group, but can also serve as a tool for understanding intragroup variability. According to the results of this study, using two fixed points creates an image that accounts for the range of variation in facial height in the population, while using three fixed points averages out facial height. The clear advantage of using the faceONface program is that, thanks to the advent of new digital technologies, it is possible to obtain a composite portrait of increased clarity, but the disadvantage is that it ignores the variability of facial height in the population. Regardless, both methodologies create a developed model that can be used by researchers, museum staff, forensic experts and other specialists.

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СОЗДАНИЕ ОБОБЩЕННОГО ПОРТРЕТА: СРАВНЕНИЕ ДВУХ МЕТОДОВ

Введение. *Одним из ценных источников антропологической информации является обобщенный портрет, который создает представление о «среднем» типе той или иной группы населения. Обобщенный портрет – это своего рода познавательный инструмент, позволяющий визуализировать интегральные морфологические характеристики изменчивости лица и элементов внешности. Данная статья посвящена сравнительному анализу двух способов создания обобщенных фотопортретов.*

Материалы и методы. *Материалом для исследования послужили фотографии женщин-санталок (N=64), по которым были построены обобщенные портреты двумя разными способами: 1) по двум фиксированным точкам в программе Adobe Photoshop; 2) по трем точкам в компьютерной программе faceONface, разработанной специально для создания обобщенных портретов.*

Результаты и обсуждение. *На обобщенном фотопортрете, полученном классическим методом Ф. Гальтона путем совмещения фотографий по двум зрачковым точкам, верхняя половина лица фиксируется более четко в области глаз, но нижний ярус лица остается нечетким и расплывчатым. При использовании третьей, ротовой, точки мы получаем более четкую картину в области рта, не теряя четкости в области глаз. В то же время построение обобщенного портрета по двум фиксированным точкам создает изображение, которое отражает весь размах изменчивости высоты лица в популяции, а при использовании трех точек высота лица усредняется.*

Заключение. *В отличие от обобщенного фотопортрета, полученного классическим методом, совмещение фотографий по трем точкам дает более привлекательное изображение, но при этом мы теряем возможность зафиксировать большой размах изменчивости высоты лица. Тем не менее, оба метода совмещения портретов создают развитую модель, которую могут использовать исследователи, сотрудники музеев, судебно-медицинские эксперты и другие специалисты.*

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Ключевые слова: биологическая антропология; обобщенный портрет; санталы; faceONface; Гальтон

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