



Perception of complex coloured eyes: Effect on inclusion of persons in a search

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ABSTRACT

To assess the variation in eye colour perception, a small set of 14 eyes with complex colouration were presented to 100 volunteers with the question whether the corresponding individuals should be in- or excluded in a search for a brown or blue-eyed person respectively. Regularly eyes were included for both searches; occasionally exclusion for both searches was given and recurrently false exclusions were obtained as based on IrisPlex prediction values. The finding that eye colour is variably perceived may influence how prediction results are communicated to and used by police investigators.

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1. Introduction

Differences in eye colour is considered to occur from variation in number and distribution of melanocytes in the iris and the type of melanin stored in these cells. Eye colour is classified in three general categories: brown/black, blue/grey and green/hazel. This latter category of complex tones is also described as intermediate. The prediction of externally visible characteristics (EVCs) may provide investigative leads to the police, particularly when DNA analysis of an evidentiary trace did not result in DNA database match or an eyewitness account is not available. Predictions may also be used to select individuals for inclusion in mass DNA screening.

Many studies have identified single nucleotide polymorphisms (SNPs) associated with eye colour and predictive assays have been built (amongst others [1–3]). As these assays aim to limit the number of SNPs that need to be analysed and because not all genomic factors and interactions are known, these assays have limitations, especially regarding the prediction of intermediate colourations, and can sometimes present a false prediction. In our laboratory, we have introduced the IrisPlex test [1] for casework. The test was presented for accurate blue and brown eye colour prediction and these eye colours are reported when a threshold

value (set at 0.70) is reached. Because the test is not optimal to predict intermediate (green/hazel) eyes, we do not report an intermediate prediction as such (unclear result).

Here, we study eye colour perception of a small set of irises with complex colourations by a panel of volunteers and asked “would you include this individual in a search (for instance a DNA mass screening) if one was looking for a brown or for a blue-eyed person”. We did not provide the volunteers with predictive values for brown or blue eye colour that had to be met, as the question remains the same irrespective how much the values are above the threshold. Also, the question could be based on an eyewitness report. IrisPlex prediction values were considered to determine whether (based on IrisPlex typing) individuals were unnecessarily included or falsely excluded for a search.

2. Material and methods

Forms with 14 eyes were presented to 100 volunteers of whom 41 are forensic scientists. Eye pictures were in part taken from [1]. The order of the eyes on the form is as presented in Table 1. No particular light conditions were used when volunteers filled in the forms. IrisPlex prediction values were taken from [1] or determined by using the procedures described in [1].




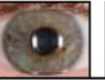


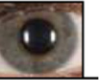




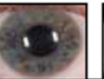
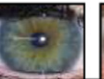

3. Results and discussion

Of the 14 eyes, some have both (light) brown and blue/grey features like spots or stripes (eyes 1, 3, 4, 5, 6, 7, 9, 12, 13, 14) whilst

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Table 1
Results of a survey on eye colour perception in which 14 eyes are examined by 100 volunteers. For the category 'falsely excluded', the IrisPlex prediction was used. Not applicable is abbreviated to na.

Eye number	1	2	3	4	5	6	7	
Eye picture								
Perception	Included in blue search	79%	92%	100%	68%	31%	100%	84%
	Included in brown search	83%	19%	2%	91%	100%	39%	87%
	Falsely excluded	21%	na	0%	32%	na	0%	16%
	Included in both searches	62%	12%	2%	61%	31%	39%	71%
	Excluded in both searches	0%	1%	0%	2%	0%	0%	0%
Prediction	Blue	0.87	0.34	0.92	0.90	0.23	0.95	0.90
	Intermediate	0.08	0.47	0.05	0.07	0.13	0.03	0.07
	Brown	0.05	0.19	0.03	0.03	0.64	0.02	0.03
	Highest prediction value	blue	intermediate	blue	blue	brown	blue	blue
	Report	blue	not clear	blue	blue	not clear	blue	blue
Eye number	8	9	10	11	12	13	14	
Eye picture								
Perception	Included in blue search	82%	93%	3%	4%	100%	99%	82%
	Included in brown search	63%	50%	99%	100%	25%	53%	82%
	Falsely excluded	na	7%	na	na	0%	1%	18%
	Included in both searches	49%	47%	2%	4%	25%	52%	64%
	Excluded in both searches	4%	2%	0%	0%	0%	0%	0%
Prediction	Blue	0.13	0.87	0.31	0.42	0.96	0.92	0.87
	Intermediate	0.18	0.08	0.14	0.22	0.03	0.05	0.08
	Brown	0.69	0.05	0.55	0.36	0.01	0.03	0.05
	Highest prediction value	brown	blue	brown	blue	blue	blue	blue
	Report	not clear	blue	not clear	not clear	blue	blue	blue

others have a unclear colouration tone (eye 2, 8) or an unclear IrisPlex prediction outcome (2, 10, 11). For each eye, 100 volunteers indicated whether they would include the corresponding individual when searching for a blue or a brown-eyed person. The percentages 'included in blue-eyed person search' and 'included in brown-eyed person search' are presented in Table 1 for each eye. In addition, we indicate how often an eye was included in both or in none of the searches. The IrisPlex prediction for each eye was used to determine whether an eye would be falsely excluded (Table 1), following the scenario that the eye colour prediction that is given to the volunteer, is prepared using IrisPlex. The results vary for the different eyes, but for some eyes the percentages 'included in both searches' and 'false exclusion' are striking. Of these two situations, only the latter one poses a problem in that the true perpetrator could be missed. No striking differences were observed for volunteers familiar or unfamiliar with DNA intelligence.

The instructions accompanying the survey were minimal; it was not mentioned that grey eyes fall in the blue category, that hazel and green colours should not be regarded blue or brown or whether differently coloured spots should be ignored or focussed on. Providing more precise guidelines may have reduced the variation in perception and seems a recommendation when eye colour predictions are used for investigation. Applying eye colour measurement tools could be useful too, although we think it will not solve the issue of how to interpret spots or stripes of different colour.

4. Conclusion

Using a small set of complex coloured irises, we show that eye colour can be differently perceived by different individuals. This has to be considered when procedures are designed to select persons for a screening (e.g. mass DNA screening) based on eye colour prediction or eyewitness testimony.

Conflict of interest

None.

Acknowledgement

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