Koinophilia and Human Facial Attractiveness

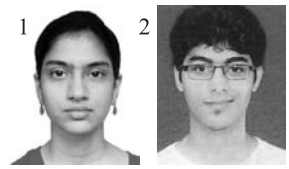
Aishwariya Iyengar, Rutvij Kulkarni and T N C Vidya

When photos of individual faces are combined together to give an averaged face, people find such averaged faces to be more attractive than the original, individual faces. This preference for the average phenotype can be described under koinophilia. In this article, we explore the reasons why averaged faces may be attractive.

Koinophilia and Human Facial Attractiveness

What makes a face attractive? There have been many studies on this topic, in the form of presenting people with photos of different faces and finding out what is common about the faces that people rate as being attractive. Some studies have found that people from different races and cultures rate the same specific faces as very attractive, suggesting that there could be some universal structural features that are attractive to humans. Preferences for attractive faces are seen even amongst infants, with infants preferring the same faces that adults judged as being attractive [1]. Other studies have found that different populations may have different standards of attractiveness [2]. People may also adjust their standards of beauty based on what they have experienced and, therefore, the media can influence beauty standards [3].

However, one very interesting and consistent finding regarding facial attractiveness has been that people find the average of faces in a population to be attractive (*Figure* 1). This was discovered in the 19th century by Francis Galton in an attempt to fashion a prototype for the 'criminal face' [4]. He discovered that when multiple photographs of faces were superimposed, the resultant face from the composite photograph looked more appealing than individual faces from any of the original contributing photographs. Much later, with the advent of computers, Langlois and Roggman averaged faces using computers and they also found



[1] Aishwariya Iyengar is a first year PhD student at JNCASR. With a background in Zoology and Biochemistry, she studies the behavioural neurogenetics of fruit flies.

[2] Rutvij Kulkarni is a first year Integrated PhD student who studied Life Sciences and Biochemistry as an undergraduate. He is interested in evolutionary biology and neuroscience.

[3] TNC Vidya is interested in animal behaviour and phylogeography, and teaches these at JNCASR. Her primary research currently is on the social organization and behaviour of Asian elephants.

Keywords
Koinophilia, attractiveness, averaged faces, recognition, mate choice.

Figure 1. Nine individual faces (a) and a composite face of these nine faces (b).

Courtesy: L DeBruine and B Jones, Face Research Lab (facelab.org). See http://faceresearch.org/demos/average for an interactive averaging of faces.

that people judged the averaged faces to be more attractive than the individual faces [5]. This preference for the 'average' has been termed koinophilia (*koinos*, Greek = common, average; *philos*, Greek = love or fondness) [6].

Averaged Faces and Symmetry

Why does a composite (averaged) face look more attractive than an individual face? One explanation is symmetry [7,8] since composite faces are more symmetric than their original images. Since individual faces may be asymmetric in different ways, by averaging several individual faces, asymmetries may cancel out one another and result in a composite face that is more symmetric. Symmetry is thought to be preferred because it possibly indicates developmental stability in a changing environment, which would

be an indicator of genetic quality in an individual.

Developmental stability is the ability of an organism to buffer its development against environmental or genetic disturbances and produce a specific phenotype. If individuals are not of high genetic quality, they may not be able to buffer their development against environmental fluctuations and this would result in asymmetries. It has been shown that people make judgments of health based on symmetry and, therefore, symmetry may serve as an honest signal of mate quality. Animals other than humans, such as swordtail fish, zebra finches, sticklebacks, and, possibly, peafowl, also prefer symmetry over asymmetry [9–11]. However, it was also found that while symmetry played a role in the perception of attractiveness in humans, its role was significant only in those faces that were initially rated as very unattractive, and perfect symmetry was not found to be necessarily attractive [12]. Moreover, averaged faces were attractive in the absence of symmetry also (when photographs of faces in profile were used) [13]. There is also another view that symmetry may not really be an indicator of genetic quality, and that preference for symmetry may simply arise from the cognitive processes associated with the mechanism of recognition in organisms [14].

Symmetry is thought to be preferred because it possibly indicates developmental stability in a changing environment, which would be an indicator of genetic quality in an individual.

Averaged Faces and Familiarity

Another characteristic of averaged faces is that they are familiar looking [12]. Familiarity has been shown to make faces appear more attractive [15]. Just as genetic quality is a possible evolutionary reason for symmetry to be preferred, what would be a possible adaptive reason for familiar faces to be preferred? The averaged face is an average of facial configurations, which would, therefore, be perceived as a prototype face of the population. (This assumes a normal distribution – otherwise the modal value should be considered as the prototype face, not the mean.) Facial recognition is an important cognitive ability in animals such as humans, in which social communication via visual cues plays a significant role in day-to-day life. It is likely that the brain recognises faces by remembering an average prototype and then comparing deviations

Koinophilia is thought to have evolved as a strategy for mate selection because common phenotypes are likely to be 'safer' than mutants.

of observed faces against it rather than by remembering exact details of specific faces [16,17]. If only deviations are noticed, average faces would appear familiar. Therefore, koinophilia would facilitate recognition of individuals of the same species and appropriate sex during mate recognition, since identifying conspecifics (individuals of same species) and the correct sex would be easier when a face is average. Average faces would, however be difficult to recognize individually as distinct individuals.

Koinophilia and Mate Selection

Koinophilia is thought to have evolved as a strategy for mate selection because common phenotypes are likely to be 'safer' than mutants (if the advantages or disadvantages of mutations can be ascertained only retrospectively and not at the time that they arise) [6]. Koinophilic mating (in which individuals mate with conspecifics showing the average phenotype) is different from assortative mating (*Figure* 2), in which individuals choose mates based on their own phenotype as opposed to choosing the average or common phenotype, irrespective of their own phenotype. Commonness would indicate that the phenotype was well suited to the environment and is, therefore, likely to have high fitness. If it were true that the common phenotype was the best suited to the environment and if this phenotype were heritable, koinophilia as a phenomenon would spread through a population in which it arose (assuming that koinophilia is itself heritable). Interestingly, koinophilia could, therefore, also be a mechanism by which traits show a distribution that mimics stabilizing selection, just as assortative mating can give rise to trait distributions akin to that obtained through disruptive selection, assuming that the traits are heritable (see *Figure* 3). Perhaps koinophilia is a mechanism that maintains the traits involved in species recognition under stabilizing selection. Another possibility is that there is some other force that maintains species-specific traits under stabilizing selection and koinophilia is an adaptation for selecting individuals given that distribution.

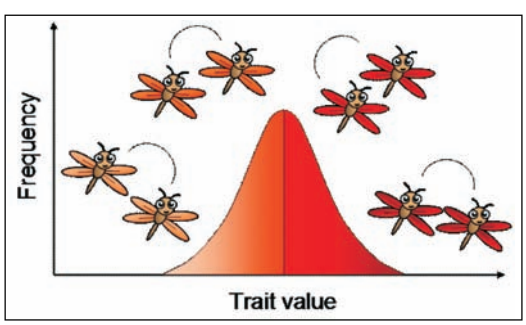


Figure 2. Assortative mating, in which individuals prefer to mate with others having similar trait values (positive assortative mating). The frequency distribution of the trait values is shown, with pairings between insects having the same wing colour. In koinophilic mating, insects of all wing colours shown here would prefer to mate with those having the intermediate wing colour (orange-red).

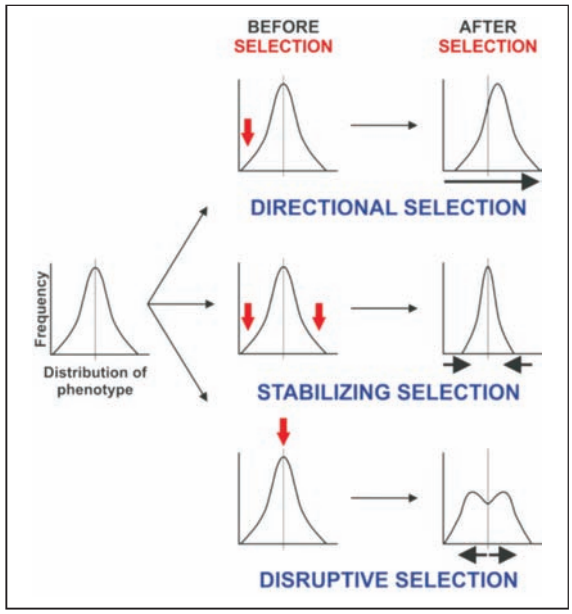


Figure 3. Types of selection. The frequency distributions of trait values (phenotypes) are shown before selection and after selection. The arrows within the three panels in the middle point towards the trait values that are selected against. The direction in which the distribution will move after selection is shown by arrows below the three panels on the right. The population mean will move towards the right under the directional selection shown above, while it will remain unchanged under stabilizing and disruptive selection. The variance in the trait decreases under stabilizing selection, while it increases under disruptive selection.
Courtesy: http://www.wikilectures.eu/index.php/File:Selectiontypes.png

Koinophilia: Further Thoughts

It has been suggested that koinophilia could also be a mechanism for speciation [6]. If individuals of a koinophilic species occupied different geographic areas with different distributions of phenotypes, the average phenotype in each area would be different, and individuals from other areas would be avoided as mates, leading to reproductive isolation. If the variability in trait values is reduced because of selection of the average phenotype, this may result in a lack of intermediate morphologies between species, as seen in the fossil record [18]. However, this would require multiple species to show koinophilia, as well as other mechanisms that lead to the initial differences in phenotypic distributions across populations.

While koinophilia has been proposed as a mechanism that can explain diverse processes, from mate choice to speciation [18,19], it cannot satisfactorily explain mate choice based on sexual ornaments (such as deer stag antlers or the peacock's tail) or the 'rare male advantage' (when the rarest males in the population are sometimes preferred by females). However, there seems to be some confusion in the literature about species recognition versus

When choosing the correct species and sex, one would expect individuals to choose those individuals whose trait values are close to the population average in order to minimize acceptance error.

individual recognition during the process of mate selection, in the context of preference for the average. Mate selection involves choosing individuals of the same species and appropriate sex, and then discriminating between individuals of this set of 'desirable individuals'. When choosing the correct species and sex, one would expect individuals to choose those individuals whose trait values are close to the population average in order to minimize acceptance error (the mistake of wrongly identifying an undesirable individual as a desirable individual). However, individuals should choose mates based on trait values that are away from the mean in the correct direction when choosing amongst a set of individuals of the appropriate gender and species. The traits used for species and sex identification, therefore, need not be the same as those used for individual discrimination. For example, secondary sexual characteristics are not expected to be useful in species identification but can be useful in individual discrimination. Therefore, koinophilia would not be expected with respect to such characteristics if it were a mechanism for choosing the correct species.

If symmetry is indeed reflective of genetic quality and developmental stability is heritable, symmetry would be a trait for which high values would be preferred both in the context of species recognition and individual preference.

Interestingly, since the averaged face is not only a prototype face of the population, but is also rated as an attractive face, faces may be used for species/sex and individual discrimination simultaneously. One would then expect different characteristics of the face to be used for discrimination at different levels. For instance, face shape at a broader level may indicate human 'faceness' while skin texture or details of face shape may indicate individual quality. Composite faces have blemishes removed and better skin texture, and it is known that skin texture is one of the cues used to rate attractiveness. This could be one reason why composite faces are preferred. If symmetry is indeed reflective of genetic quality and developmental stability is heritable, symmetry would be a trait for which high values would be preferred both in the context of species recognition (because this would represent the population average) and individual preference (because the averaged face would represent a high, not average, degree of symmetry, which would be indicative of quality). Attractiveness also de-

Box 1. Glossary

Developmental stability: This is the ability of an organism to buffer its development against disturbances (environmental or genetic) and produce a predicted phenotype from a specific genotype [25].

Fitness: The ability of individuals of a particular genotype or phenotype to contribute offspring to the next generation. This can be assessed in absolute terms or relative to other genotypes/phenotypes.

Trait value: A distinct variant of a phenotypic character, for e.g., 'black' is a trait value of the trait 'hair colour'.

Natural selection: This is a natural process by which heritable biological traits change in frequency in a population because of differential reproductive success of individuals that carry variants of these traits. In other words, individuals that are best adapted to their environment survive and reproduce to a greater extent than other individuals because of heritable variation that the former individuals possess. Natural selection is a mechanism by which populations evolve.

Stabilizing selection: This is a type of natural selection in which the intermediate phenotype is the most fit and extreme values of the trait are selected against.

Disruptive selection: This is a type of natural selection in which extreme phenotypes (in either direction, which are farthest from the mean) are the most fit and intermediate phenotypes are selected against.

Directional selection: This is a type of natural selection in which one extreme phenotype is the fittest and the intermediate phenotypes and the other extreme phenotype are selected against.

Assortative mating: This is a non-random mating pattern in which individuals preferentially mate with those who have the same phenotype as them (positive assortative mating) or with those individuals who have a different phenotype from them (negative assortative mating).

Honest signal: This is a signal (behaviour or phenotype used actively by an individual to transmit information and influence the behaviour of another individual) that correctly represents the state of the signaller.

Acceptance error: This is the misidentification of an 'undesirable' individual as a 'desirable' one. In the case of mate selection, an undesirable individual may be one from another species, but during kin recognition, most individuals of the same species would also be undesirable.

Rejection error: This is the misidentification of a desirable individual as an undesirable one.

pends on various other cues that the face bears, as well as the state of the individual who is doing the rating [20]. It has also been found that while averaged faces are attractive, the most attractive faces are not average and often have some unusual characteristic about them [21, 22]. These unusual characteristics may serve as signals of quality and there could be directional selection on

Surprisingly, it has been found that the preference for the average is not limited to faces: people also rated averaged heterospecifics, such as birds or fish, and artifacts, such as watches or cars, as more attractive than their non-average counterparts.

them, with the preferred individuals showing trait values away from the population mean.

Surprisingly, it has been found that the preference for the average is not limited to faces: people also rated averaged heterospecifics, such as birds or fish, and artifacts, such as watches or cars, as more attractive than their non-average counterparts [23]. This raised the question about whether there was any mate-selection advantage to preferring the average or whether it was simply an outcome of how information is processed in the brain . It has subsequently been shown that familiarity (which could also partly stem from selective manufacturing of items with certain attractive traits) seems to fully account for attractiveness of the average amongst artifacts but only partially influences attractiveness of the average amongst humans and other animals [23]. Therefore, there is probably an evolved preference for the average face.

While there is some evidence for other species avoiding unusual or unfamiliar looking mates [24], a preference for the average, as seen in humans, has not been tested. In primates, preference for symmetry has been tested for but not averageness. This is partly constrained by the inability of our perceptual abilities to determine the perception of test animals. It will be interesting to see if other species show koinophilic behaviours using visual and non-visual sensory modalities. Further research in this direction may reveal much about recognition and mate-selection.

Suggested Reading

[1] **J H Langlois, L A Roggman, R J Casey, J M Ritter, L A Rieser–Danner, V Y Jenkins, Infant preferences for attractive faces: rudiments of a stereotype?, *Developmental Psychology*, Vol.23, No.3, pp.363–369, 1987.**

[2] **D Jones and K Hill, Criteria of facial attractiveness in five populations, *Human Nature*, Vol.4, No.3, pp.271–296, 1993.**

[3] **D T Kenrick and S E Gutierres, Contrast effects and judgments of physical attractiveness: when beauty becomes a social problem, *Journal of Personality and Social Psychology*, Vol.38, No.1, pp.131—140, 1980.**

[4] **F Galton, Composite portraits, *Nature*, Vol.18, pp.97–100, 1878.**

[5] **J H Langlois and L A Roggman, Attractive faces are only average, *Psychological Science*, Vol.1, No.2, pp.115–121, 1990.**

[6] J H Koeslag, Koinophilia: Groups sexual creatures into species, promotes stasis, and stabilizes social behaviour, *Journal of Theoretical Biology*, Vol.144, No.1, pp.15–35, 1990.

[7] K Grammer and R Thornhill, Human (*Homo sapiens*) facial attractiveness and sexual selection: The role of symmetry and averageness, *Journal of Comparative Psychology*, Vol.108, No.3, pp.233–242, 1994.

[8] D I Perrett, D M Burt, I S Penton–Voak, K J Lee, D A Rowland and R Edwards, Symmetry and human facial attractiveness, *Evolution and Human Behavior*, Vol.20, No.5, pp.295–307, 1999.

[9] M R Morris and K Casey, Female swordtail fish prefer symmetrical sexual signal, *Animal Behaviour*, Vol.55, No.1, pp.33–39, 1998.

[10] J P Swaddle and I C Cuthill, Female zebra finches prefer males with symmetric chest plumage, *Proceedings of the Royal Society*, Vol.258, No.1353, pp.267–271, 1994.

[11] J T Manning and M A Hartley, Symmetry and ornamentation are correlated in the peacock's train, *Animal Behavior*, Vol.42, No.6, pp.1020–1021, 1991.

[12] J H Langlois, L A Roggman and L Musselman, What is average and not average about attractive faces?, *Psychological Science*, Vol.5, No.4, pp.214–220, 1994.

[13] T I M Valentine, S Darling and M Donnelly, Why are average faces attractive? The effect of view and averageness on the attractiveness of female faces, *Psychonomic Bulletin and Review*, Vol.11, No.3, pp.482–487, 2004.

[14] J P Swaddle, Fluctuating asymmetry, animal behaviour, and evolution, *Advances in the Study of Behavior*, Vol.32, pp.169–205, 2003.

[15] L A Zebrowitz, B White and K Wieneke, Mere exposure and racial prejudice: Exposure to other-race faces increases liking for strangers of that race, *Social Cognition*, Vol.26, No.3, pp.259–275, 2008.

[16] D A Leopold, I V Bondar and M A Giese, Norm-based face encoding by single neurons in the monkey inferotemporal cortex, *Nature*, Vol.442, No.7102, pp.572–575, 2006.

[17] M K Unnikrishnan, How is the individuality of a face recognized?, *Journal of Theoretical* Biology, Vol. 261, No.3, pp.469–474, 2009.

[18] J H Koeslag, On the engine of speciation, *Journal of Theoretical Biology*, Vol. 177, No.4, pp.401–409, 1995.

[19] J H Koeslag and P D Koeslag, Koinophilia, *Journal of Theoretical Biology*, Vol.167, No.1, pp.55–65, 1994.

[20] A C Little, B C Jones, L M DeBruine, Facial attractiveness: evolutionary based research, *Philosophical Transactions of the Royal Society B*, Vol.366, No.1571, pp.1638–1659, 2011.

[21] D I Perrett, K A May, S Yoshikawa, Facial shapes and judgements of female attractiveness, *Nature*, Vol. 368, No.6468, pp.239–242, 1994.

[22] T R Alley and M R Cunningham, Averaged faces are attractive, but very attractive faces are not average, *Psychological Science*, Vol.2, No.2, pp.123–125, 1991.

[23] J Halberstadt and G Rhodes, It's not just average faces that are attractive: computer-manipulated averageness makes birds, fish, and automobiles attractive, *Psychonomic Bulletin and Review*, Vol.10, No.1, pp.149–156, 2003.

[24] P Bateson, Sexual imprinting and optimal outbreeding, *Nature*, Vol.273, pp.659–660, 1978.

[25] C H Waddington, Canalization of development and the inheritance of acquired characters, *Nature*, Vol.150, No.3811, pp.563–565, 1942.

Address for Correspondence
T N C Vidya
Evolutionary and Organismal Biology Unit
Jawaharlal Nehru Centre for Advanced Scientific Research
Jakkur,
Bengaluru 560 064, India.
Email: tncvidya@jncasr.ac.in