Personality and Individual Differences 53 (2012) 4–8

Contents lists available at SciVerse ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Review

Do pigmentation and the melanocortin system modulate aggression and sexuality in humans as they do in other animals?

J. Philippe Rushton [a,*], Donald I. Templer [b]

[a] Department of Psychology, University of Western Ontario, London, Ontario, Canada N6A 5C2
[b] California School of Professional Psychology, Alliant International University, Fresno, CA 93704, United States

ARTICLE INFO

Article history:
Received 13 November 2011
Received in revised form 19 February 2012
Accepted 20 February 2012
Available online 15 March 2012

Keywords:
Pigmentation
Skin color
Aggression
Sexual activity
HIV/AIDS
Crime
IQ
Life history theory

ABSTRACT

Pigmentation of the hair, skin, cuticle, feather and eye is one of the most salient and variable attributes of vertebrates. In many species, melanin-based coloration is found to be pleiotropically linked to behavior. We review animal studies that have found darker pigmented individuals average higher amounts of aggression and sexual activity than lighter pigmented individuals. We hypothesize that similar relationships between pigmentation, aggression, and sexuality occur in humans. We first review the literature on non-human animals and then review some of the correlates of melanin in people, including aggression and sexual activity. Both *within* human populations (e.g., siblings), and *between* populations (e.g., races, nations, states), studies find that darker pigmented people average higher levels of aggression and sexual activity (and also lower IQ). We conceptualize skin color as a multigenerational adaptation to differences in climate over the last 70,000 years as a result of "cold winters theory" and the "Out-of-Africa" model of human origins. We propose life history theory to explain the covariation found between human (and non-human) pigmentation and variables such as birth rate, infant mortality, longevity, rate of HIV/AIDS, and violent crime.

1. Introduction

Across species, pigmentation of the hair, skin, cuticle, feather and eye is mainly determined by the melanocortin system (a group of peptide hormones secreted by the pineal gland) and is one of the phenotypes that varies most among vertebrates (Ducrest, Keller, & Roulin, 2008). Individuals with darker pigmentation are found to be pleiotropically linked to higher levels of aggression, sexuality, and social dominance than individuals with lighter pigmentation. (Pleiotropy is the phenomenon whereby a single gene has two or more phenotypically different effects. A classic example of pleiotropy in human diseases is phenylketonuria [PKU], which can cause mental retardation and reduced hair and skin pigmentation.) Even before the term was proposed there were examples of distinct traits that seemed to be inherited together. In his classic 1866 paper, Mendel (1822–1884) listed his trait number three in peas as having brown seed coat, violet flowers, and axial spots. In humans, darker skin also correlates with lower IQ (Rushton & Jensen, 2005).

2. Animal studies

Ducrest et al. (2008) reviewed data on over 40 wild vertebrate species showing that within each species, darker pigmented individuals averaged higher levels of aggression and sexual activity than lighter pigmented individuals, with a larger body mass, more resistance to stress, and greater physical activity when grooming. The relationship between coloring and behavioral dominance was robust across three species of mammal (African lion, soay sheep, and white-tailed deer), four species of fish (mosquito fish, guppy, green swordtail, and Arctic charr), four species of reptile (asp viper, adder, fence lizard, and spiny lizard), one amphibian species (spadefoot toad) and 36 species of bird.

In captive Hermann's tortoises (*Eurotestudo boettgeri*), another reptile species, Mafli, Wakamatsu, and Roulin (2011) found darker shell coloration predicted greater aggressiveness and boldness. Darker individuals were more aggressive in male–male confrontations and bolder towards humans, independent of body size and ambient temperature. (Melanin based color traits are a criterion in mate choice.)

Validation of the pigmentation system as causal to the naturalistic observations was demonstrated by experimentally manipulating pharmacological dosages and by studies of cross-fostering (Ducrest et al., 2008). Thus, melanocortin hormone levels predicted the amount of testosterone and other sexual steroids along with

* Corresponding author.
E-mail addresses: Rushton@uwo.ca (J.P. Rushton), donaldtempler@sbcglobal.net (D.I. Templer).

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http://dx.doi.org/10.1016/j.paid.2012.02.015

concomitant increases (or decreases) in aggression and sexual behavior. Placing darker versus lighter pigmented individuals with adoptive parents of the opposite pigmentation did not modify offspring behavior. Male lions with darker manes remained more aggressive and sexually active than those with lighter manes, and darker feathered barn owls continued to have a stronger immune response to stress than lighter feathered barn owls. It was the biological, not adopting parent who determined coloration in the offspring.

The biological and behavioral responses are a finely regulated balance between neurotransmitters and hormones at the level of the whole organism. The genes that control that balance occupy a high level in the hierarchical system of the genome. The system is defined anatomically as a collection of central nervous system circuits which include neurons that express peptides and proteins that originate in the arcuate nucleus and the brainstem. Downstream, targets of these melanocortin hormones bind to five melanocortin receptors, each one being associated with different physiological and behavioral functions. (For a review of the biochemistry of the melanocortin system, see Fong (2003); for a review of pharmacological effects, see Roulin and Ducrest (2011).)

Further, Roulin and Ducrest (2011) describe the role of the melanocortin system in activating the MC1 receptor induced by the production of brown to black eumelanic pigments. Activation of four other melanocortin receptors affected stress response, energy homeostasis, female sexual receptivity and male sexual performance. These were mediated by the production of sexual steroids including testosterone. Although numerous genes interact to stabilize an organism's development, the lead role belonged to the genes controlling the functioning of the neural and endocrine systems. However, Ducrest et al. (2008) cautioned, because of genetic mutations, melanin-based coloration may not exhibit these traits consistently across human populations.

Pigmentation change in wild silver foxes (*Vulpes vulpes*) was one outcome of breeding for tameness. It was the Russian geneticist Belyaev (1917–1986) who found that selecting easy-to-handle foxes pulled along with it many features that distinguish domestic animals from their wild forebears including white patches in the fur, droopy ears, a smaller skull, and a faster reproductive cycle (Trut, 2003; Trut, Iliushina, Prasolova, & Kim, 1997). Domesticated foxes reached sexual maturity a month earlier (at 7 months) than non-domesticated foxes, and gave birth to litters averaging one pup larger (about six). After 40 years and the breeding of 45,000 foxes, Belyaev's successor, Trut (2003) had animals as tame and eager to please as a dog. The pattern of coat color that had evolved as camouflage in the wild, depigmented to piebold, one of the most striking mutations among domestic animals and seen frequently in dogs, cats, sheep, donkeys, horses, pigs, goats, mice, and cattle. About 35% of the co-variation in the domesticated traits was genetic in origin as assessed by cross fostering newborns and transplanting embryos between wild and tame foxes. Because behavior is rooted in biology, selection for tameness selected for physiological characteristics with broad effects.

Similar effects of de-pigmentation have been found in laboratory rats, which are typically albinos with white coats and pink eyes. Black rats are more aggressive (and so also make poorer pets). However, black rats with white spots (from the "white spotting gene") are calmer and more easily handled. A 15-year study of selection for tameness over 30 generations in wild Norway rats (*Rattus norvegicus*) found the percentage of piebald rats increased rapidly until over 70% had white bellies and about 50% had white feet and ankles or "socks" as they are called (Trut et al., 1997). In this experiment in rats, selection for tameness correlated with their depigmentation.

Dogs too, show a relationship between coloring and behavior (Coren, 2011). Black dogs are more difficult to get adopted from shelters and are rated as less desirable as pets. Using computer images of black, brown, and yellow Labrador Retrievers to control for size, pose, and background, Coren found people had more negative attitudes to the black than to the brown or yellow retrievers. Observers rated the black dogs as less friendly, less likely to make a good pet, and to be more aggressive. Assuming that people's attitudes and beliefs about dogs have some validity, this study provides further support for the pigmentation hypothesis.

3. Human studies

A first examination of whether melanin based pigmentation plays a role in human aggression and sexuality (as seen in non-human animals), is to compare people of African descent with those of European descent and observe whether darker skinned individuals average higher levels of aggression and sexuality (with violent crime the main indicator of aggression). Internationally, we found Blacks are over-represented in crime statistics relative to Whites and Asians. In Canada, a government commission found that Blacks were five times more likely to be in jail than Whites and 10 times more likely than Asians (Ontario, 1996). In Britain, the Home Office (1999) found that Blacks, who were 2% of the general population, made up 15% of the prison population. In the US, Taylor and Whitney (1999) analyzed the FBI Uniform Crime Statistics and National Crime Victimization Surveys from the US Department of Justice and found that since record keeping began at the turn of the century and throughout the 1960s, 1970s, 1980s, and 1990s, African Americans engaged in proportionately more acts of violence than other groups. Since victims' surveys tell a similar story, the differences in arrest statistics cannot just be attributed to police prejudice.

Lynn (2002) reviewed the literature on psychopathy in childhood and adolescence and found that Blacks averaged the highest rates including diagnosis with childhood conduct disorder, Attention Deficit Hyperactivity Disorder (ADHD), being suspended or excluded from school, scoring low on tests of moral understanding, failing to live up to financial obligations such as paying back student loans, poor work commitment, recklessness (e.g., having traffic accidents), maintaining monogamous relationships, being responsible parents, engaging in domestic violence, and needing hospitalization for injuries sustained through altercations.

Rushton and Whitney (2002) analyzed the 1993–1996 INTERPOL Yearbooks and found that across 100 countries, the rate of murder, rape, and serious assault is four times higher in African and Caribbean countries than elsewhere in the world. In violent crimes per 100,000 people, the rate for African countries was 149; for European, 42; and for Asian, 35. These results are similar to those carried out on other data sets from INTEROL and the United Nations. They show the Black overrepresentation in violent crime to be a worldwide phenomenon.

In regard to sexual behavior, differences between Blacks and Whites also support the pigmentation hypothesis. In an early international survey, Ford and Beach (1951) asked married couples how often they had sex each week. Pacific Islanders and Native Americans said from 1 to 4 times, US Whites answered 2–4 times, while Africans said 3 to over 10 times. Later surveys confirmed and extended these findings. Rushton and Bogaert (1987), Rushton and Bogaert (1988) examined 41 items from the Kinsey data and found that Blacks not only had a higher rate of intercourse at an earlier age and with more partners, but also had more orgasms per act of coitus, spent more time thinking about sex, and had lower levels of sex guilt. Black females became pregnant more quickly indicated by speed of pregnancy after demobilization. Race predicted sexual behavior better than did socioeconomic status. Kinsey's Black sample was college educated (from 1938 to 1963) and came from a middle class background (parentally intact, with high educational