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- determinants are sometimes more apparent: clothes and chairs are made to fit human bodies. Usually, of course, factors of all three types interact. For instance, the shape of cars is determined by cultural heritage from the horse carriage and by continuously changing fashions, by the pressure of the physical environment (streamlining, etc.) and by the need to accommodate people.

Greater interest attaches to cases in which the biological factors involve not physical characteristics of the human body but human behavioural propensities. Lorenz (1950) called attention to such influences on the shapes of dolls and cartoon characters. He suggested that nurturance and affection are elicited by certain key features: a short face in relation to a large forehead, protruding cheeks, maladjusted limb movements, etc. Dolls have come to emphasize or exaggerate these features, cartoon characters do likewise, and those animals most often selected as pets tend also to have them. Lorenz's suggestion has received some experimental support (Gardner & Wallach 1965; Fullard & Reiling 1976; Sternglanz et al. 1977).

Further evidence in favour of the operation of selection through these human proclivities is provided by changes in artefacts over time. Gould (1980) has documented the manner in which, as the early mischievous and somewhat cruel Mickey Mouse evolved into the more lovable character of recent years, his head proportions changed in a manner conforming with Lorenz's suggestions.

Such a correlation cannot by itself provide convincing evidence for a role of human propensities to respond nurturantly to particular stimulus characteristics. However parallel evolution in an unrelated species renders such an interpretation more plausible. A recent exhibition of teddy bears in the Cambridge Folk Museum provided some further relevant data. The teddy bear originated at the beginning of the century from a picture associating the U.S. President, Theodore Roosevelt, after a hunt in the Rocky Mountains, with a brown bear in the background. The earliest teddy bear in the collection, dated 1903, had a low forehead and a long snout, and was muzzled. A survey of the other bears in the collection showed a trend over time towards a larger forehead and a shorter snout relative to the dimensions of the head as a whole.

Figure 1A shows how the ratio of vertical distance between the eyes and the highest point of the crown, to the vertical distance between the eyes and the base of the head, has changed over time. On the assumption that the museum specimens were drawn from the population at each time at random with respect to this character, there is evidence for a clear trend over time towards a larger forehead (Spearman rank order correlation, $r_s = 0.52$,

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The Evolution of the Teddy Bear

The factors moulding the development of human social behaviour in the individual can be grouped into three interdependent categories: those deriving from his social and cultural environment, from his physical situation, and from his biological nature. These act both directly by affecting behaviour, and by affecting preferences through which one style of behaviour is selected over another. Whilst the ubiquitous nature of cultural factors often masks the importance of the others, full understanding requires appreciation of all three. Similar principles apply to human artefacts, and here biological

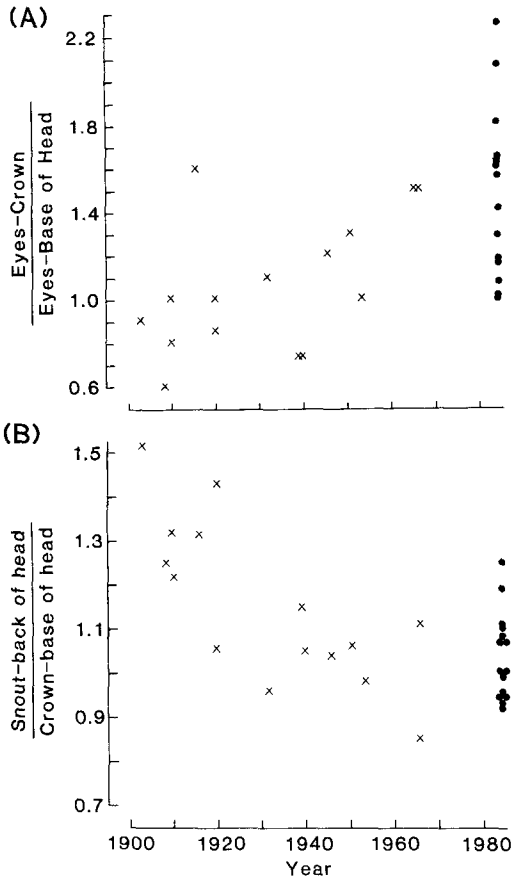


Figure 1. Changes with time in (A) ratio of the vertical distance from eyes to crown to that from eyes to base of head and (B) ratio of distance between tip of snout and back of head to distance between top of head and its base. Crosses indicate specimens from the Museum collection of teddy bears, dots those from a shop in Cambridge in 1984.

$P < 0.05$, two-tailed, for museum specimens, all measured from photographs). Of course it is to be expected that at any one time, considerable intra-specific variation would be present, and this is exemplified in the 1984 data. These were obtained by direct measurement of specimens from one of the aggregations of this species to be found on shop ledges in November/December. The aggregation contained a number of variants, each in a number of sizes. Within each variant, the ratio was fairly constant, indicating an absence of allometry. Only one specimen of each variant is included in Fig. 1. Although the variance is considerable, the median is in harmony with the general trend over time.

Figure 1B shows the ratio of the distance between the tip of the snout and the back of head to the distance between the top of the head and its

base. A clear trend towards a relatively shorter snout is shown ($r_s = -0.74$, $P < 0.01$ for the museum specimens), though this change was apparently complete by the 1930s.

Some of the aberrant individuals are of interest. Figure 1A includes a remarkable individual in 1916, perhaps a representative of a line whose lack of immediate success was due to counter-selection by the inertia of prevailing fashion. Another, present in the 1984 aggregation, certainly merits specific distinctiveness on account of its very small brain case (ratio eyes-crown/eyes-base of head = 0.59, not shown in Fig. 1). This line, the Pooh bear, first appears in the records in the 1920s and has always been known for its lack of intelligence.

Of course teddy bears do not reproduce, but they are made for sale. Those types more successful in leaving the shop ledges in one year are likely to be more strongly represented there in the next. We can thus picture the process involved in the evolution of such artefacts as a form of selection determined by human preferences. However the issue is complicated in at least two ways. First, the material on which selection acts cannot be presumed to vary randomly with respect to selection: since the artefacts' creators are cognizant of the selective forces, new 'mutants' are likely to occur in the same direction as that in which selection acts. Second, the artefacts themselves may create or enhance preferences, and thus the selective forces, through the feedback effects of fashion.

Evidence for the role of selection based on particular human propensities in the evolution of artefacts is most readily obtained from the accumulation of instances. These data, coupled with those provided by Gould, provide some further confirmation of the importance of the Lorenzian 'baby characteristics'. They do not, of course, show whether, or how far, responsiveness to these characteristics depends on direct experience of babies.

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Vigilance During 'Easy' and 'Difficult' Foraging Tasks

Milinski (1984) has shown that sticklebacks (*Gasterosteus aculeatus* L.), feeding on a high density swarm of prey, are more likely to overlook a predator than when they are feeding on low densities of prey. He suggested that this was due to the reduced ability of the nervous system to process two different types of sensory data as each of the two tasks gets harder, and he supported this idea by quoting analogous research on human sensory processes. The perceptual effects that are associated with selective attention in humans have also been discovered in pigeons (Blough 1979). Similarly, in a discussion of the different strategies of vigilant scanning adopted by two species of wader, Metcalfe (1984) suggested that the exploitation of prey types with short handling times allowed purple sandpipers (*Calidris maritima*) to scan more efficiently than turnstones (*Arenaria interpres*). In other words, because they chose 'easy' prey, the purple sandpipers were potentially better able to avoid attack by predators.

In a previous paper I compared the foraging efficiency of blackbirds (*Turdus merula* L.) searching for cryptic and conspicuous food (Lawrence 1985b). Analysis of the vigilance behaviour measured during repeated short feeding bouts on the two sorts of food showed that birds appeared to alter their vigilance behaviour quantitatively depending on the difficulty of the feeding task.

My study took place at two sites near Southampton University, Hampshire, U.K. during the early summers of 1980 and 1981. The basic method was to record the behaviour of individually colour-ringed adult blackbirds feeding on 200 small (4.5 mm × 4.5 mm) cylindrical pastry baits scattered on the surface of metal trays (0.7 m × 0.8 m) filled with small pebbles set in casting plaster (described more fully by Lawrence 1985a). The baits were coloured green using food dye and they were placed either on a background matching in colour (green painted),

or contrasting in colour (brown). For convenience the prey under the former condition were termed 'cryptic' and those under the latter 'conspicuous'. Before the experiment started, the blackbirds were pre-trained on the pastry pellets for 2–8 weeks to visit the feeding stations regularly. There were eight subjects (all adults: six males, two females) and each bird received a random sequence of eight tests: four tests with conspicuous prey and four tests with cryptic prey (Lawrence 1985b). Each feeding site was close to cover (2–8 m from evergreen bushes and trees), and attracted groups of garden passerines feeding at ground level: robins, *Erithacus rubecula*; great tits, *Parus major*; blue tits, *P. caeruleus*; and chaffinches, *Fringilla coelebs*. These birds were exposed to potential avian predators (sparrowhawks, *Accipiter nisus* and kestrels, *Falco tinnunculus*) as well as to disturbance from people. During the study at the sites I recorded (1) the capture by a kestrel of a robin that was feeding on one of the backgrounds; (2) three attacks on mist-net trapped blackbirds by male and female sparrowhawks (despite the fact that the blackbirds had just been trapped and I was in the process of extracting them); and (3) regular sightings of sparrowhawks hunting during a total of about 120 visits (I recorded 1–3 sightings per eight visits). Before they approached the backgrounds the blackbirds appeared to scrutinize them for 1–4 min from the cover of evergreen bushes. They then walked or hopped up to the edge (with frequent upward scans), fed rapidly and continuously (apart from breaks for vigilance: for definition see below) for up to 70 s, and then departed abruptly, straight for cover. The average total time spent feeding on backgrounds containing cryptic prey was longer than for conspicuous prey (29.0 ± 5.0 s and 16.0 ± 1.7 s (± 1 SE) respectively, $t = 2.7$, $df = 7$, $P < 0.05$, t -test). There was no evidence that tests with conspicuous prey suffered more rapid depletion of baits compared with cryptic prey: on average there were 180 cryptic and 182 conspicuous prey available at the start of each bird's feeding bout ($T = 14$, $N = 8$, $P > 0.05$, Wilcoxon test). My definition for vigilance behaviour during these feeding bouts follows that used by Barnard (1980) and Metcalfe (1984), i.e. a 'scan' occurs when the head of the bird is up and scanning the surroundings. In this context, vigilance could be interpreted as 'a state of readiness to detect and respond to certain small changes occurring at random time intervals in the environment', a definition used by experimental psychologists (Parasuraman 1984). Whereas granivorous birds may scan whilst handling food (Lendrem 1984), blackbirds invariably handled the prey without raising their heads to an upright posture.