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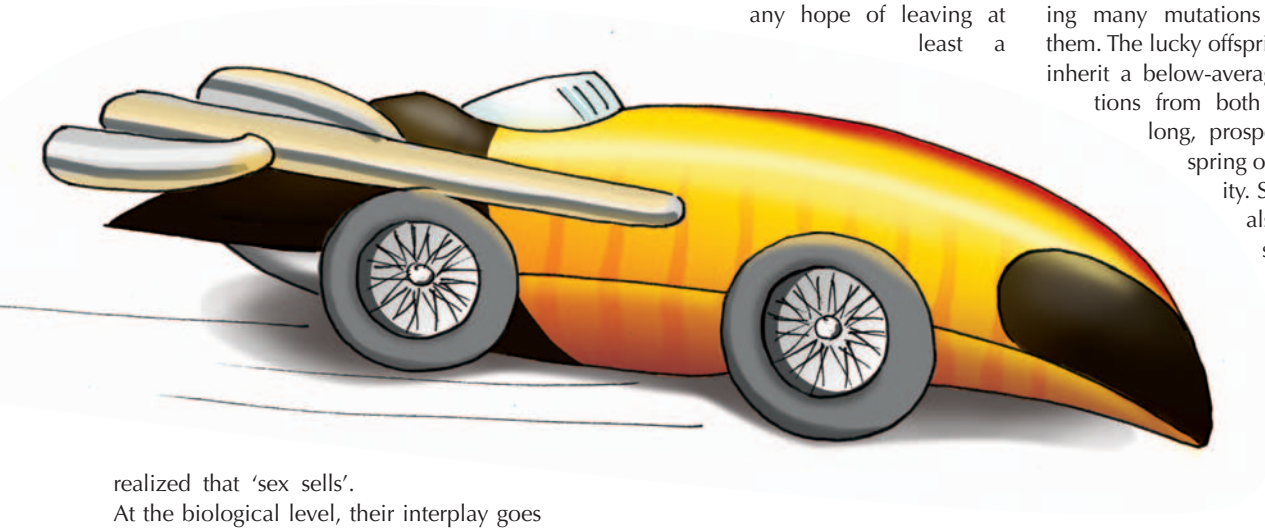
# Sex, mutations and marketing

How the Cambrian explosion set the stage for runaway consumerism

*Geoffrey Miller*

Sex and marketing have been coupled for a very long time. At the cultural level, their relationship has been appreciated since the 1960s 'Mad Men' era, when the sexual revolution coincided with the golden age of advertising, and marketers realized that 'sex sells'.



At the biological level, their interplay goes much further back to the Cambrian explosion around 530 million years ago. During this period of rapid evolutionary expansion, multicellular organisms began to evolve elaborate sexual ornaments to advertise their genetic quality to the most important consumers of all in the great mating market of life: the opposite sex.

Maintaining the genetic quality of one's offspring had already been a problem for billions of years. Ever since life originated around 3.7 billion years ago, RNA and DNA have been under selection to copy themselves as accurately as possible [1]. Yet perfect self-replication is biochemically impossible, and almost all replication errors are harmful rather than helpful [2]. Thus, mutations have been eroding the genomic stability of single-celled organisms for trillions of generations, and countless lineages of asexual organisms have suffered extinction through mutational meltdown—the runaway accumulation of copying errors [3]. Only through wildly profligate self-cloning could such organisms have any hope of leaving at least a few offspring with no new harmful mutations, so they could best survive and reproduce.

Around 1.5 billion years ago, bacteria evolved the most basic form of sex to minimize mutation load: bacterial conjugation [4]. By swapping bits of DNA across the pilus (a tiny intercellular bridge) a bacterium can replace DNA sequences compromised by copying errors with intact sequences from its peers. Bacteria finally had some defence against mutational meltdown, and they thrived and diversified.

Then, with the evolution of genuine sexual reproduction through meiosis, perhaps around 1.2 billion years ago, eukaryotes made a great advance in their ability to purge mutations. By combining their genes with a mate's genes, they could produce progeny with huge genetic variety—and crucially with a wider range of mutation loads [5]. The unlucky offspring who happened to inherit an above-average number of harmful mutations from both parents would die young without reproducing, taking many mutations into oblivion with them. The lucky offspring who happened to inherit a below-average number of mutations from both parents would live long, prosper and produce offspring of higher genetic quality. Sexual recombination also made it easier to spread and combine the rare mutations that happened to be useful, opening the way for much faster evolutionary advances [6]. Sex became the foundation of almost all complex life because it was so good at both short-term damage limitation (purging bad mutations) and long-term innovation (spreading good mutations).

Yet, single-celled organisms always had a problem with sex: they were not very good at choosing sexual partners with the best genes, that is, the lowest mutation loads. Given bacterial capabilities for chemical communication such as quorum-sensing [7], perhaps some prokaryotes and eukaryotes paid attention to short-range chemical cues of genetic quality before swapping genes. However, mating was mainly random before the evolution of longer-range senses and nervous systems.

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All of this changed profoundly with the Cambrian explosion, which saw organisms undergoing a genetic revolution that increased the complexity of gene regulatory networks, and a morphological revolution that increased the diversity of multicellular body plans. It was also a neurological and psychological revolution. As organisms became increasingly mobile, they evolved senses such as vision [8] and more complex nervous systems [9] to find food and evade predators. However, these new senses also empowered a sexual revolution, as they gave animals new tools for choosing sexual partners. Rather than hooking up randomly with the nearest mate, animals could now select mates based on visible cues of genetic quality such as body size, energy level, bright coloration and behavioural competence. By choosing the highest quality mates, they could produce higher quality offspring with lower mutation loads [10]. Such mate choice imposed selection on all of those quality cues to become larger, brighter and more conspicuous, amplifying them into true sexual ornaments: biological luxury goods such as the guppy's tail and the peacock's train that function mainly to impress and attract females [11]. These sexual ornaments evolved to have a complex genetic architecture, to capture a larger share of the genetic variation across individuals and to reveal mutation load more accurately [12].

Ever since the Cambrian, the mating market for sexually reproducing animal species has been transformed to some degree into a consumerist fantasy world of conspicuous quality, status, fashion, beauty and romance. Individuals advertise their genetic quality and phenotypic condition through reliable, hard-to-fake signals or 'fitness indicators' such as pheromones, songs, ornaments and foreplay. Mates are chosen on the basis of who displays the largest, costliest, most precise, most popular and most salient fitness indicators. Mate choice for fitness indicators is not restricted to females choosing males, but often occurs in both sexes [13], especially in socially monogamous species with mutual mate choice such as humans [14].

Thus, for 500 million years, animals have had to straddle two worlds in perpetual tension: natural selection and sexual selection. Each type of selection works through different evolutionary principles and dynamics, and each yields different types of adaptation and biodiversity. Neither fully dominates the other, because sexual attractiveness without survival is a short-lived vanity, whereas ecological competence without reproduction is a long-lived sterility. Natural selection shapes species to fit their geographical habitats and ecological niches, and favours efficiency in growth, foraging, parasite resistance, predator evasion and social competition. Sexual selection shapes each sex to fit the needs, desires and whims of the other sex, and favours conspicuous extravagance in all sorts of fitness indicators. Animal life walks a fine line between efficiency and opulence. More than 130,000 plant species also play the sexual ornamentation game, having evolved flowers to attract pollinators [15].

The sexual selection world challenges the popular misconception that evolution is blind and dumb. In fact, as Darwin emphasized, sexual selection is often perceptive and clever, because animal senses and brains mediate mate choice. This makes sexual selection closer in spirit to artificial selection, which is governed by the senses and brains of human breeders. In so far as sexual selection shaped human bodies, minds and morals, we were also shaped by intelligent designers—who just happened to be romantic hominids rather than fictional gods [16].

Thus, mate choice for genetic quality is analogous in many ways to consumer choice for brand quality [17]. Mate choice and consumer choice are both semi-conscious—partly instinctive, partly learned through trial and error and partly influenced by observing the choices made by others. Both are partly focused on the objective qualities and useful features of the available options, and partly focused on their arbitrary, aesthetic and fashionable aspects. Both create the demand that suppliers try to understand and fulfil, with each sex striving to learn the mating preferences of the other, and marketers striving to understand consumer preferences through surveys, focus groups and social media data mining.

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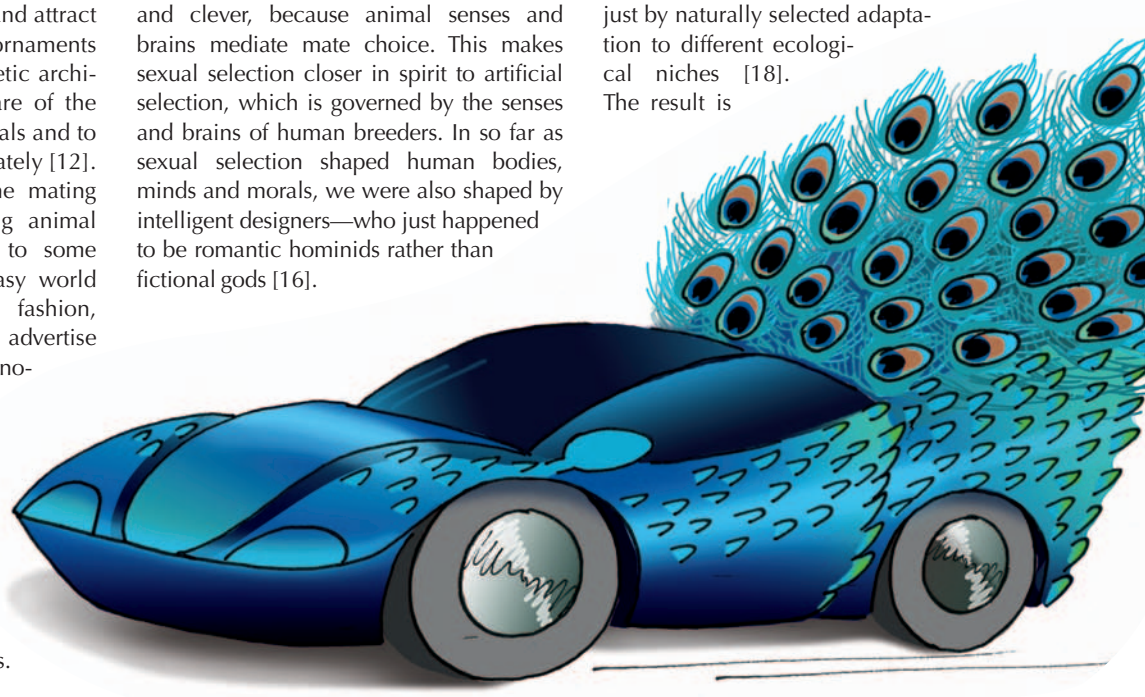
Mate choice and consumer choice can both yield absurdly wasteful outcomes: a huge diversity of useless, superficial variations in the biodiversity of species and the economic diversity of brands, products and packaging. Most biodiversity seems to be driven by sexual selection favouring whimsical differences across populations in the arbitrary details of fitness indicators, not just by naturally selected adaptation to different ecological niches [18]. The result is



that within each genus, a species can be most easily identified by its distinct mating calls, sexual ornaments, courtship behaviours and genital morphologies [19], not by different foraging tactics or anti-predator defences. Similarly, much of the diversity in consumer products—such as shirts, cars, colleges or mutual funds—is at the level of arbitrary design details, branding, packaging and advertising, not at the level of objective product features and functionality.

These analogies between sex and marketing run deep, because both depend on reliable signals of quality. Until recently, two traditions of signalling theory developed independently in the biological and social sciences. The first landmark in biological signalling theory was Charles Darwin's analysis of mate choice for sexual ornaments as cues of good fitness and fertility in his book, *The Descent of Man, and Selection in Relation to Sex* (1871). Ronald Fisher analysed the evolution of mate preferences for fitness indicators in 1915 [20]. Amotz Zahavi proposed the 'handicap principle', arguing that only costly signals could be reliable, hard-to-fake indicators of genetic quality or phenotypic condition in 1975 [21]. Richard Dawkins and John Krebs applied game theory to analyse the reliability of animal signals, and the co-evolution of signallers and receivers in 1978 [22]. In 1990, Alan Grafen eventually proposed a formal model of the 'handicap principle' [23], and Richard Michod and Oren Hasson analysed 'reliable indicators of fitness' [24]. Since then, biological signalling theory has flourished and has informed research on sexual selection, animal communication and social behaviour.

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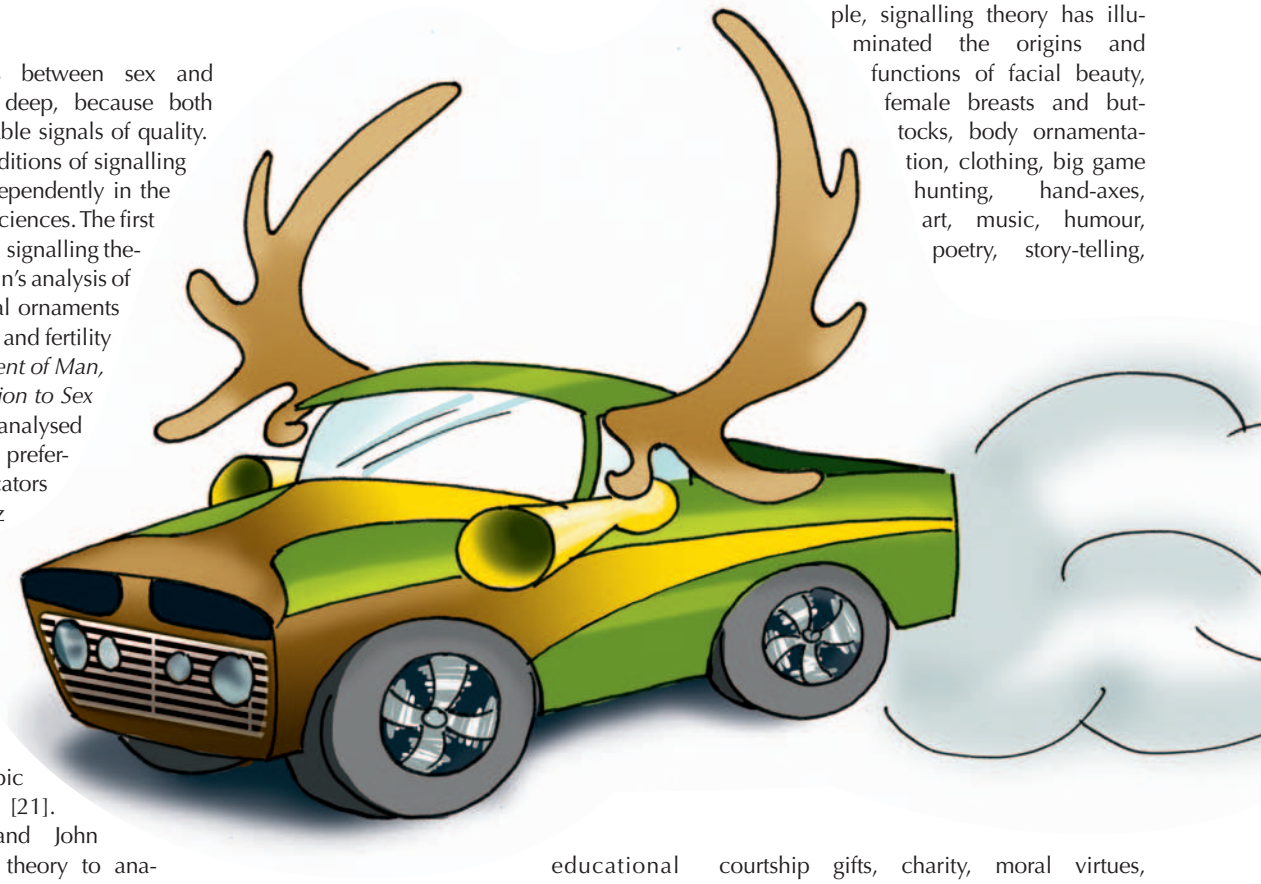
The parallel tradition of signalling theory in the social sciences and philosophy goes back to Aristotle, who argued that ethical and rational acts are reliable signals of underlying moral and cognitive virtues (*ca* 350–322 BC). Friedrich Nietzsche analysed beauty, creativity, morality and even cognition as expressions of biological vigour by using signalling logic (1872–1888). Thorstein Veblen proposed that conspicuous luxuries, quality workmanship and educational credentials act as reliable signals of wealth, effort and taste in *The Theory of the Leisure Class* (1899), *The Instinct of Workmanship* (1914) and *The Higher Learning in America* (1922). Vance Packard used signalling logic to analyse social class, runaway consumerism and corporate careerism in *The Status Seekers* (1959), *The Waste Makers* (1960) and *The Pyramid Climbers* (1962), and Ernst Gombrich analysed beauty in art as a reliable signal of the artist's skill and effort in *Art and Illusion* (1977) and *A Sense of Order* (1979). Michael Spence developed formal models of educational credentials as reliable signals of capability and conscientiousness in *Market Signalling* (1974). Robert Frank used signalling logic to analyse job titles, emotions, career ambitions and consumer luxuries in *Choosing the Right Pond* (1985), *Passions within Reason* (1988), *The Winner-Take-All-Society* (1995) and *Luxury Fever* (2000).

Evolutionary psychology and evolutionary anthropology have been integrating these two traditions to better understand many puzzles in human evolution that defy explanation in terms of natural selection for survival. For example, signalling theory has illuminated the origins and functions of facial beauty, female breasts and buttocks, body ornamentation, clothing, big game hunting, hand-axes, art, music, humour, poetry, story-telling, courtship gifts, charity, moral virtues, leadership, status-seeking, risk-taking, sports, religion, political ideologies, personality traits, adaptive self-deception and consumer behaviour [16,17,25–29].



Building on signalling theory and sexual selection theory, the new science of evolutionary consumer psychology [30] has been making big advances in understanding consumer goods as reliable signals—not just signals of monetary wealth and elite taste, but signals of deeper traits such as intelligence, moral virtues, mating strategies and the 'Big Five' personality traits: openness, conscientiousness, agreeableness, extraversion and emotional stability [17]. These individual traits are deeper than wealth and

taste in several ways: they are found in the other great apes, are heritable across generations, are stable across life, are important in all cultures and are naturally salient when interacting with mates, friends and kin [17,27,31]. For example, consumers seek elite university degrees as signals of intelligence; they buy organic fair-trade foods as signals of agreeableness; and they value foreign travel and avant-garde culture as signals of openness [17]. New molecular genetics research suggests that mutation load accounts for much of the heritable variation in human intelligence [32] and personality [33], so consumerist signals of these traits might be revealing genetic quality indirectly. If so, conspicuous consumption can be seen as just another 'good-genes indicator' favoured by mate choice.

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Indeed, studies suggest that much conspicuous consumption, especially by young single people, functions as some form of mating effort. After men and women think about potential dates with attractive mates, men say they would spend more money on conspicuous luxury goods such as prestige watches, whereas women say they would spend more time doing conspicuous charity activities such as volunteering at a children's hospital [34]. Conspicuous consumption by males reveals that they are pursuing a short-term mating strategy [35], and this activity is most attractive to women at peak fertility near ovulation [36]. Men give much higher tips to lap dancers who are ovulating [37]. Ovulating women choose sexier and more revealing clothes, shoes and fashion accessories [38]. Men living in towns with a scarcity of women compete harder to acquire luxuries and accumulate more consumer debt [39]. Romantic gift-giving is an important tactic in human courtship and mate retention, especially for men who might be signalling commitment [40]. Green consumerism—preferring eco-friendly products—is an effective form of conspicuous conservation, signalling both status and altruism [41].

**…biodiversity seems driven by sexual selection favouring whimsical differences […] Similarly […] diversity in consumer products […] is at the level of arbitrary design...**

Findings such as these challenge traditional assumptions in economics. For example, ever since the Marginal Revolution—the development of economic theory during the 1870s—mainstream economics has made the 'Rational Man' assumption that consumers maximize their expected utility from their product choices, without reference to what other consumers are doing or desiring. This assumption was convenient both analytically—as it allowed easier mathematical modelling of markets and price equilibria—and ideologically in legitimizing free markets and luxury goods. However, new research from evolutionary consumer psychology and behavioural economics shows that consumers often desire 'positional goods' such as prestige-branded luxuries that signal social position and status through their relative cost, exclusivity and rarity. Positional goods create 'positional externalities'—the harmful social side-effects of runaway status-seeking and consumption arms races [42].

These positional externalities are important because they undermine the most important theoretical justification for free markets—the first fundamental theorem of welfare economics, a formalization of Adam Smith's 'invisible hand' argument, which says that competitive markets always lead to efficient distributions of resources. In the 1930s, the British Marxist biologists Julian Huxley and J.B.S. Haldane were already wary of such rationales for capitalism, and understood that runaway consumerism imposes social and ecological costs on humans in much the same way that runaway sexual ornamentation imposes survival costs and extinction risks on other animals [16]. Evidence shows that consumerist status-seeking leads to economic inefficiencies and costs to human welfare [42]. Runaway consumerism might be one predictable result of a human nature shaped by sexual selection, but we can display desirable traits in many other ways, such as green consumerism, conspicuous charity, ethical investment and through social media such as Facebook [17,43].

Future work in evolutionary consumer psychology should give further insights into the links between sex, mutations, evolution and marketing. These links have been important for at least 500 million years and probably sparked the evolution of human intelligence, language, creativity, beauty, morality and ideology. A better understanding of these links could help us nudge global consumerist capitalism into a more sustainable form that imposes lower costs on the biosphere and yields higher benefits for future generations.

CONFLICT OF INTEREST

The author declares that he has no conflict of interest.

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***Geoffrey Miller wrote* The Mating Mind *and* Spent, *and is an Associate Professor in the Psychology Department, University of New Mexico, Albuquerque, USA.***
***E-mail: gfmiller@unm.edu***

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