
Op Ed

Natural Selection and High Heels

Euclid O. Smith* and Whitney S. Helms
Atlanta, Georgia

EDITORIAL COMMENT

This new section of the journal has been added to provide readers with a broader contact with specific information. In many cases, information which is of interest to the reader but does not conform to the strict peer review guidelines is available. We welcome submissions from our readers with opinions, ideas, or essays that are of interest to the readers of *Foot & Ankle International*.

Lowell D. Lutter, M.D.
Editor-in-Chief
Foot & Ankle International

Millions of women wear high heel shoes every day. By doing so, women are engaging in a potentially dangerous and risky practice that seems illogical in strict terms of Darwinian fitness. It is the intersection of a widespread cultural trait and our basic fitness-enhancing evolutionary underpinnings that are of particular interest. The rise in popularity of high heels is the type of cultural oddity that invites an anthropological perspective. Disrupting our fundamental pattern of locomotion is a dramatic pattern of behavior that may have significant negative consequences for the individual.^{1,2} However, this practice is part of a larger pattern of human behavior in which women, as well as men, alter their appearance to become more socially acceptable and, hopefully, more interesting to the opposite sex. Not only will men and women attempt to attract the interest of the opposite sex, but in doing so they engage in competition with members of their own

sex through a variety of fitness-enhancing practices. Examples of this competition include wearing makeup, undergoing plastic surgery, and dressing in fashionable apparel.

There are a number of historically known examples of the development of cultural traditions that were fitness-enhancing (e.g., agriculture, modern medicine) and these traits are wholly consistent with Darwinian fitness maximization. In the strictest sense, fitness maximization refers to the process of maximizing one's genetic representation in future generations. Darwin recognized that evolutionary success was more than simply maximizing offspring survivorship and reproduction, although he was unaware of mechanisms of heredity. What is fascinating are the traits exhibited by modern humans that are widely practiced but are actually detrimental to Darwinian fitness (e.g., smoking cigarettes, eating large quantities of fatty foods, and bungee jumping). Reasons why such traits persist in modern populations vary widely, but consider the possibility that individuals who engage in these cultural practices are being directed, in at least a small part, by their genetic heritage. By that, I mean that although there is no specific gene for a cultural trait (e.g., agriculture), individuals who evolved certain psychological predispositions to engage in technological behavior, take risks, or engage in experimentation may have also developed cultural traits that contributed to their Darwinian fitness. These derived cultural traits arose directly from the evolved psychological predispositions. On the other hand, evolved psychological predispositions, which initially may have directed behavior in fitness-enhancing ways, have been co-opted by other behavioral systems in ways that are today fitness-reducing. Risk taking by men was probably fitness-enhancing during our evolutionary history,

Department of Anthropology, Emory University, Atlanta, Georgia.

* To whom requests for reprints should be addressed at Department of Anthropology, Emory University, 1557 Pierce Dr., Atlanta, GA 30322.

but today, extraordinary risk taking by men does not yield the same fitness benefits as it did in the past.

Alternatively, traits may persist in human populations that are not driven by any underlying genetic predisposition but are the outcome of cultural practices that persist in the face of biological costs. Although nicotine is a highly addictive drug, initial experimentation with smoking by individuals is almost surely culturally orchestrated. Youngsters, to be more socially accepted, often begin smoking at an early age, and it is only after some period of unpleasant physical sensations (dizziness, nausea, and headaches) do they habituate to the nicotine inhalation.²¹ Social acceptance is the underlying force here. I would argue that we have a number of highly evolved psychological mechanisms that have guided our behavior in largely fitness-enhancing ways and that social acceptance, in an evolutionary context, was probably of considerable importance in our evolutionary history. Ostracism from what must have been small, largely kin-based social groups would have been tantamount to reproductive failure, and in many cases, death.⁸ Therefore, it is likely that we have evolved powerful psychological mechanisms that direct our behavior toward sociality. I do not suggest that there is a gene for response to peer pressure but that we have psychological predispositions that have been selected.

What does this have to do with high heels? Wearing high heels may offer an example of an evolved cultural display directed by sexual selection. Although no gene exists for wearing high heels, the tendency to engage in behavior that maximizes fitness exists in humans, as it does in all other living organisms. Although this tendency does not favor wearing high heels directly, it may well be that women who wore high heels or other cultural accoutrements were more attractive to potential mates. In this way, the tendency to wear high heels is motivated by more general psychological mechanisms that have driven women to engage in cultural practices that would make them desirable to men.

A number of studies have implicated high heels in causing, or at least exacerbating, foot disorders.^{6,7} High heel shoes are some of the most deforming and unnatural shoes ever designed. The long arch of the foot is elevated vertically with pressure directed toward the toes, rather than distributed evenly between the toe and heel. The arch is, thus, no longer an arch.⁹ Shoes of this design seek to convert the anterior portion of the arch into a supporting column. When one looks at the rectangular shape of the foot and the triangular shape of the toe box of virtually all high heels, it is clear that the forefoot becomes constricted in the toe box. Additional downward pressure caused by the elevation of the heel forces the foot into the

constricting, triangular toe box.⁷ The effects on the foot of such unnatural restrictions and the fundamental reorientation of the center of gravity have a number of unanticipated adverse consequences, such as sprained ankles,¹⁶ lower back pain,⁵ shortened Achilles tendon,²⁰ altered standing posture,¹⁴ increased oxygen consumption,¹⁵ and reduced walking speed and mobility.^{1,2}

Discussions of the reasons why women wear high heels have generally been discounted as simply "fashion." Conforming to culturally proscribed patterns of dress, however, must have some positive fitness-enhancing aspects. We argue that for humans, as well as all other species, signaling about physical condition or reproductive state is a basic aspect of sexual selection. In most cases, males engage in elaborate displays, whereas females assess the displays of males to choose the most fit partner. Members of Western society are paradoxical in that females exhibit displays that are often as extravagant as those of males¹³ and may be as risky as some of the mate-attraction practices of males. High heels are a prime example of the sexual signaling practiced by human females.

A woman wearing high heels sends a variety of messages that reveal her receptivity, sexuality, confidence, and power. Rossi¹⁹ concludes that "... high heels may well be the most potent aphrodisiac ever concocted ... high heels sensuously alter the whole anatomy." High heels go much beyond sexual symbolism and actually enhance the sexual attractiveness of a woman through various means¹⁹: (1) they give more shapely contours to the ankle and leg; (2) they make the foot look smaller¹⁰⁻¹² and the arch and the instep more femininely curved; (3) they cause postural changes that accentuate the shape and movement of the lower limbs, the pelvis and buttocks, the abdomen and bosom, the curve of the back, and the carriage^{3,17}; (4) they feminize the gait by causing a shortening of the stride¹⁸; and (5) they add to the height of the wearer and provide a psychological and emotional uplift that enhances sexual attraction.⁴ The advantages in mate selection gained by women wearing heels may far outweigh the physical trauma that high heels incur. Clearly, women are engaging in a behavior that pits major short-term fitness payoffs against long-term fitness costs. This practice is interesting from an anthropological perspective, for it is clearly a culturally mediated trait, as evidenced by the fact that women continue to wear high heels long after they have attracted a mate. If the trait were directly favored through selection, wearing high heels would not have been favored in females who had already secured a mate.

Women wearing high heels draw attention to specific phenotypic characters that they consider important in attracting a mate. Human females walk in potentially debilitating and life-threatening high heels to advertise their sexuality with the goal of attracting a partner.

When our basic biology and our culture seem to run counter to each other, we are confronted with a pattern of human behavior that is of considerable anthropological interest. High heels are clearly maladaptive, in the strict sense of the physical harm they impose on the wearer. Nonetheless, millions of women continue to wear them daily in the face of well known and well documented problems that high heels impose on the wearer. High heels are a cultural trait that continues in Western populations in spite of its potentially fitness-reducing properties. Outweighing the fitness-reducing properties are the perceived benefits enjoyed by the wearers of high heels. The way these psychological predispositions are played out varies from culture to culture, but the traits may actually impose substantial immediate costs to the wearers. High heels offer an extraordinary example of the interaction of biology and culture in shaping behavior. High heels seem to serve to focus attention on the wearer and to advertise certain anatomical characteristics that human males find attractive.

This discussion has argued that that high heels are a culturally derived and defined signal that has evolved in the context of sexual selection. Human females use a variety of devices to signal intentions about mating, and, like other cultural accoutrements, high heels serve a signaling function in human society that more than offsets the potential costs associated with their use. Like the tails of peacocks, the displays of the widow bird, and the antlers of a male moose, high heels communicate important information about the mating suitability of the wearer, even though they pose a substantial risk to those who engage in the display.

REFERENCES

1. **Alexander, R.M.:** Human locomotion. In Jones, S., Martin, R., and Pilbeam, D. (eds.), *The Cambridge Encyclopedia of Human*

- Evolution. New York, Cambridge University Press, 1992. pp. 80-85.
2. **Alexander, R.M.:** *The Human Machine*. New York, Columbia University Press, 1992.
3. **Bendix, T., Sorensen, S.S., and Klausen, K.:** Lumbar curve, trunk muscles, and line of gravity with different heel heights. *Spine*, **9**:223-227, 1984.
4. **Buss, D.:** *The Evolution of Desire: Strategies of Human Mating*. New York, Basic Books, 1994.
5. **Cailliet, R.:** *Low Back Pain Syndrome*. Philadelphia, F.A. Davis, 1995.
6. **Coughlin, M.J.:** Women's shoe wear and foot disorders. *West. J. Med.*, **163**:569-569, 1995.
7. **Coughlin, M.J., and Thompson, F.M.:** The high price of high-fashion footwear. *Instr. Course Lect.*, **44**:371-377, 1995.
8. **Dunbar, R.I.M.:** Social behaviour and evolutionary theory. In Jones, S., Martin, R., and Pilbeam, D. (eds.), *The Cambridge Encyclopedia Of Human Evolution*. New York, Cambridge University Press, 1992, pp. 145-147.
9. **Estabrooks, G.H.:** *Man: The Mechanical Misfit*. New York, MacMillan, 1941.
10. **Frey, C.:** Trends in women's footwear. *Instr. Course Lect.*, **44**:385-387, 1995.
11. **Frey, C., Thompson, F., and Smith, J.:** Update on women's footwear. *Foot Ankle Int.*, **16**:328-331, 1995.
12. **Frey, C., Thompson, F., Smith, J., Sanders, M., and Horstman, H.:** American Orthopaedic Foot and Ankle Society women's shoe survey. *Foot Ankle*, **14**:78-81, 1993.
13. **Low, B.:** Human sex differences in behavioral ecological perspective. *Analyse & Kritik*, **16**:38-67, 1994.
14. **Maring-Klug, R.:** Reducing low back pain during pregnancy. *Nurse Pract.*, **7**:18-24, 1982.
15. **Mathews, D.K., and Wooten, E.P.:** Analysis of oxygen consumption of women while walking in different styles of shoes. *Arch. Phys. Med. Rehabil.*, **99**:569-571, 1963.
16. **Nieto, E., and Nahigian, S.H.:** Severe ankle injuries while wearing elevated "platform" shoes. *Ohio Med.*, **71**:137-141, 1975.
17. **Opila-Correia, K.A.:** Kinematics of high-heeled gait. *Arch. Phys. Med. Rehabil.*, **71**:304-309, 1990.
18. **Opila, K.A., Wagner, S.S., Schiowitz, S., and Chen, J.:** Postural alignment in barefoot and high-heeled stance. *Spine*, **13**:542-547, 1988.
19. **Rossi, W.A.:** High heels: the agony and the ecstasy. *J. Am. Podiatr. Med. Assoc.*, **71**:698-699, 1981.
20. **Scholl, W.:** *The Human Foot: Anatomy, Physiology, Mechanics, Deformities, and Treatment*. Springfield, IL, Charles C. Thomas, 1931.
21. **Warren, C.W., Kann, L., Small, M.L., Santelli, J.S., Collins, J.L., and Kolbe, L.J.:** Age of initiating selected health-risk behaviors among high school students in the United States. *J. Adolesc. Health*, **21**:225-231, 1997.