John R. Skoyles (1999) THE EVOLUTIONARY PSYCHOLOGY OF PERFECTIONISM. Psycoloquy: 10(054) brain expertise (7)

PSYCOLOQUY (ISSN 1055-0143) is sponsored by the American Psychological Association (APA).

http://www.cogsci.ecs.soton.ac.uk/cgi/psyc/newpsy?10.054

THE EVOLUTIONARY PSYCHOLOGY OF PERFECTIONISM
Reply to Prudkov on Brain-Expertise

John R. Skoyles
6 Denning Road,
Hampstead,
London, NW3 1SU
United Kingdom
http://www.human-existence.com
j.skoyles@ucl.ac.uk

Abstract

Prudkov (1999) suggests an alternative to my proposal (Skoyles, 1999a) that the near doubling of human brain size since Homo erectus arose to increase our capacity for expertise. His criticism is that long term motivations are needed for the acquisition of expertise. Prudkov has identified a weakness in the present literature in the subfield that studies expertise: what is the nature and origin of the motivation -- perfectionism -- that leads people to engage in the prolonged practice needed to become experts? I show that this motivation is peculiar, species-specific and appears to be central to human evolution. However, it complements rather than replaces (as suggested by Prudkov) the role of expertise in the evolutionary near doubling of human brain size.

Keywords

brain size, brain imaging, evolution, expertise, hemispherectomy, Homo erectus, individual differences, intelligence, IQ, language, microcephaly, MRI volumetrics, psychometrics.

1. Expertise is the term psychologists use for high levels of skill acquired in areas as diverse as chess, music, sport, computer programming, and reading x-rays. The attainment of such high levels of skill has been found to require at the minimum ten years of several hours daily focused practice -- practice, moreover, that needs to be continued if a high level of competence is to be maintained (Ericsson & Lehmann, 1996). From such focused practice, many tens of thousands of information chunks that enable experts to identify the solution to a problem (Gobet, & Simon, 1996). The classic example of this is the chess player who, on seeing pieces upon a board during a game, can use such chunks of information to instantly see several moves ahead. Because they are dependent upon chunks of information processing, such skills are also likely to depend upon the number of available neural columns in the brain (Jerison, 1991). Some support for this exists in motor skills, where controls have shown that experts expand the area of the brain devoted to this skill (Elbert, Pantev, Wienbruch, Rochstroh, & Taub, 1995). Since IQ links only moderately to brain size, and indeed some people with microcephalia have normal IQ (reviewed in the target article), I suggest that human brain expansion is linked to the natural selection of increased capacity for expertise rather than IQ. There is evidence that the survival of hunter-gatherers is dependent upon expertise, for example, in prey tracking (Lee, 1979). I therefore propose that natural selection selected those early hominids best able to develop expertise, those ones with the largest number of neural columns and therefore the greatest capacity for storing the information chunks upon which expertise depends. As a result, evolution pushed for an increase in brain size.

2. Prudkov makes an important and constructive criticism of this conjecture. He notes that expertise depends upon long-term motivation: "to acquire expertise in a particular domain an individual must take years or even decades and overcome the many problems inevitable in this process. Only with a strong domain-specific motivation is such perseverance possible" (para 5). Such motivation, moreover, must be plastic to social influences: "An individual cannot become an expert (e.g., a great chess player) in a domain that is completely absent from his social environment" (para 6). He suggests that the capacity for long term motivation underlies not only the culture of Palaeolithic humans, but more recently the capacity of humans to develop civilisation. As he notes, "The ability to construct and maintain long-term motivations with no innate basis may be the greatest achievement of evolution". His suggestions are important, though I see them as complimentary, rather than contrary, to my proposal.

3. The motivation required to sustain the acquisition of expertise would appear in some ways to be anomalous. After all, expertise requires several hours of focused practice that is not in itself a leisure activity (Ericsson, Krampe & Tesch-Rmer, 1993). This focused practice must be undertaken daily by young people for a minimum of a decade (Ericsson & Lehmann, 1996), and requires individuals to divert energy and time from other activities which are more immediately important to life and survival. Moreover, deliberate practice must be maintained, despite (1) constant frustrations, (2) the fact that skill improvements are hardly noticeable on a day to day basis, and (3) the fact that it offers little leisure or play (those researching expertise find no correlation between time spent upon nondeliberate fun activities and expertise (see Ericsson, Krampe & Tesch-

Rmer, 1993). In spite of these factors, some individuals do manage to motivate themselves to engage in sustained regular practice for a decade or more.

4. While external factors such as parental rewards and instructions can explain some engagement in deliberate practice (Ericsson, 1996, pp 26-27), it cannot explain cases of inner motivation such as musicians like Leonard Bernstein whose parents were initially opposed to his learning the piano. Indeed, Ericsson notes that "the 'talent' of adolescents and adult expert athletes is assessed by master coaches to a large degree in terms of their perception of the athlete's desire to succeed and motivation to train", and that "The locus of such individual differences in obsessive interests in focused engagement in activities of a specific domain is still poorly understood" (Ericsson, 1996, p. 27; Howe, Davidson & Sloboda 1998).

5. That such an inner motivation exists is acknowledged by the English word "perfectionism", which refers to motivation which lacks fun or play, but gains reward from small incremental improvements, and maintains perseverance during frustration. This word, however, merely describes a motivational phenomena, without explaining why its nature or why it exists.

6. Three things, however, can be observed: first, the perfectionism needed to engage in the ten years minimum daily deliberate practice to become an expert is species specific to us. As Prudkov notes, para 7, "No nonhuman animal seems to have a motivational system with similar characteristics". Other animals might practise skills, but this rarely continues for more than a few hours on a particular day until they are mastered. It is only humans who will spend several hours daily seeking to master a skill, and will carry on doing so for at least three and half thousand days, and, in the case of some musicians, a lifetime. Second, the variety of expertise found in the modern world -- chess, sport, programming, prediction of racing from, radiology -- suggests a motivation with a remarkable degree of domain plasticity. Third, this motivation does not allow false performance feedback. For example, chess players seeking to improve their abilities would never seek to win games against grandmasters by any means but their own. This motivation is concerned with learning a skill as a personal competence, and not merely with gaining the effect (through help and artificial aids) of skill.

7. Unfortunately, there is little empirical research into perfectionism as a motivation. Even so, evolutionary psychology would seem to provide a tentative rationale for its existence -- that perfectionism evolved because it offers adaptational advantages. While immediate survival might be compromised by perfectionism, such a motivation could be required for the development of skills that offer compensating long-term advantages. For this reason, it may have been selected for during the course of human evolution.

8. To illustrate its adaptive importance, consider the case of one of the many skills vital to early hominid survival: stone-tool manufacture. The ability to use stone-tools increases people's capacity to dig, kill, butcher, and clean food, and could have been a critical skill for survival. Stone-tool making, however, is not a skill which can be passed on genetically, nor can it easily be socially transmitted, although tuition and example might

be useful. What is needed for successful tool making is a substantial amount of deliberative practice. Evolution would therefore select for brains that possessed the motivation for prolonged, small incremental improvement practice (perfectionism) to enable the development of the specialised dexterity necessary for tool-making. The bases for its selection exist: even hominids without such motivation could make simple stone tools of limited utility; however, individuals with a small amount of perfectionism would create better ones (sharper edges, more easily held grips, better suited to needs). This small increase could then be the basis for further natural selection of stronger perfectionism motivation. Moreover, the skill of creating such devices would Increase the efficiency of food acquisition and processing. This would in turn provide the increased resources necessary to support the time spent in practising the development of better skills. Thus there would exist a positive feedback loop that would not only sustain such selection, but over time, amplify it.

9. This adaptationist account should be distinguished from the more conventional adaptationist type of evolutionary psychology, in that here natural selection provided us with an innate capacity to acquire specialised noninnate skills rather than innate skills. To separate these two different kinds of evolutionary effects upon cognition, I shall refer to the conventional approach as type I evolutionary psychology, and to this alternative approach as type II evolutionary psychology.

10. Type I evolutionary psychology argues that complex cognitive skills much like physiological organs (such as the eye) are innate adaptations which arose during the Pleistocene by a process of natural selection. While it accepts that such skills might be shaped by learning (much as organs like the eye are adjusted for focal length during their development), it denies that cognitions arise de nova from experience - they are not learned but genetically inherited. This is the approach of such people as Pinker (1997), Tooby and Cosmides (1992) and Buss (1999).

11. Type II evolutionary psychology argues that natural selection played an equally important role in shaping the human mind, but at the level of increasing the ability of humans to learn noninnate skills, either from social transmission or personal experience. Neuroscience finds that the brain is neurally plastic, and is made up of neural circuits that can acquire complex noninnate skills. For example, neurons in the primary visual cortex can become Braille reading neurons, owing to neural plasticity (Cohen et al, 1997). Neural plasticity is accessible as a potential if a neural circuit is already committed to a function (those in the visual cortex of the blind are free of their normal function of sight, and are therefore free to process Braille). Thus, evolution has an easy way of expanding the ability of the brain to acquire noninnate cognitions, and vastly expanding brain size. This creates a brain full of neural circuits which are lacking in assigned function, and can now underlie the processing of acquired skills. By modifying the brain in this and in other ways, human evolution shaped human cognition by selecting for traits that enhanced the ability of the hominid brain to acquire nonevolved skills. This provided the human species with the potential to radically change, in terms of both cognitions and life-style, and answers a question which remains unanswered by evolutionary psychology I, namely: why is it that although we evolved as simple hunter-gatherers, we ended up

living a very different existence as educated people in modern industrial states? (Skoyles, 1997; 1999b).

12. Evolutionary psychology II is concerned to understand how evolution enabled people to become good at acquiring noninnate complex abilities. As noted above, brain size increase was one factor that provided vast numbers of neural columns -- something I argued in my target article underlies our capacity for expertise -- but it is unlikely to be the only one. In order to acquire complex abilities from experience or social transmission, it is necessary to invest considerable time and focused attention, and to be sufficiently motivated to engage in deliberative practice. This suggests that evolution selected a specialised motivation, perfectionism, so that humans could become capable of the perseverance necessary in order to learn noninnate abilities. Thus the evolution of the capacity to acquire complex skills (including those of expertise) required changes to the motivational system. Like other inherited traits enabling us to acquire novel abilities, these changes were domain nonspecific. The perfectionism motivation that might have enabled early humans to engage in the deliberative practice needed to acquire, say, the skills for making stone tools, could, in modern people motivate the continued practice necessary for becoming a chessmaster, a virtuoso musician, or an Olympic gold medallist.

13. While these observations are indebted to Prudkov's commentary, he proposes that it is long-term motivation which is needed to support the development of expertise that underlies the expansion of human brain size, rather than expertise itself: "Maintaining a learned motivational process during a long period is a new brain function likely to require a big and complex brain." (para 10) Prudkov fails, however, to explain why the evolution of such a motivation should be linked to brain size rather than, say, changes to the limbic system (a much more likely candidate). Whether perfectionism arises from enlarged brains or focused adaptations to the limbic system is an important question and one which should be accessible to empirical investigation, for example, by comparing during fMRI the brain activations of musicians playing in deliberative practice or for pleasure.

14. In conclusion, I think Prudkov's observations are important: if brain size expanded to enable us to possess expertise, then we need to consider the possibility that specialised motivations would have also been evolved so that hominids could maintain and sustain the deliberate practice needed to acquire it.

REFERENCES

Buss, D. M. (1999). Evolutionary psychology. Boston: Allyn & Bacon.

Cohen, L. G., Clenik, P., Pascial-Leone, A., Corwell, B., Faiz, L., Dambrosla, J., Honda, M., Sadato, N., Gerfoff, C., Catala, M. D., & Hallett, M. (1997). Functional relevance of cross-modal plasticity in blind humans. Nature, 398, 180-183.

Elbert, TH., Pantev, C., Wienbruch, C. Rochstroh, B. & Taub, E. (1995). Increased cortical representation of the fingers of the left hand in string players. Science, 270, 305-307.

Ericsson, K. A., Krampe, R. T., & Tesch-Rmer, C. (1993). The role of deliberative practice in the acquisition of expert performance. Psychological Review, 100, 363-406.

Ericsson, K. A., & Lehmann, A. C. (1996). Expert and exceptional performance: Evidence of maximal adaptation to task constraints. Annual Review of Psychology, 47, 273-305.

Ericsson, K. A. (1996). The acquisition of expert performance: An introduction to some of the issues. In The road to excellence: The acquisition of expert performance in the arts and sciences, sports and games (Ed. K. A. Ericsson), pp. 1-49, Mahwah, New Jersey, Erlbaum.

Gobet, F., & Simon, H. A. (1996). Recall of random and distorted chess position: Implication for the theory of expertise. Memory and Cognition, 24, 493-503.

Howe, M.J.A., Davidson, J.W., & Sloboda, J.A. (1998). Innate talents: Reality or myth? Behavioral and Brain Sciences, 21, 399-414.
http://www.cogsci.soton.ac.uk/bbs/Archive/bbs.howe.html

Jerison, H. (1991). Brain size and the evolution of mind. Fifty- ninth James Arthur lecture on the evolution of the human brain. New York: American Museum of Natural History.

Lee, R. B. (1979). The !Kung San: Men, women, and work in a foraging society. Cambridge: Cambridge University Press.

Pinker. S. (1997). How the mind works. New York: Norton.

Prudkov, P. Commentary on Skoyles, J.R. (1999a). Human evolution expanded brains to increase expertise capacity, not IQ. PSYCOLOQUY 10(002).
ftp://ftp.princeton.edu/pub/harnad/Psycoloquy/1999.volume.10/ psyc.99.10.012.brain-expertise.3.prudkov http://www.cogsci.soton.ac.uk/cgi/psyc/newpsy?10.012

Skoyles, J. R. (1997). Evolution's 'missing link': A hypothesis upon neural plasticity, prefrontal working memory and the origins of modern cognition. Medical Hypothesis, 48, 499-509.

Skoyles, J.R. (1999a). Human evolution expanded brains to increase expertise capacity, not IQ. PSYCOLOQUY 10(002).
ftp://ftp.princeton.edu/pub/harnad/Psycoloquy/1999.volume.10/ psyc.99.10.002.brain-expertise.1.skoyles http://www.cogsci.soton.ac.uk/cgi/psyc/newpsy?10.002

Skoyles, J. R. (1999b). Neural plasticity and exaptation. American Psychologist, 54, 438-439.

Tooby, J. & Cosmides, L. (1992). Psychological foundations of culture. In J. Barkow, L. Cosmides, & J. Tooby (Eds.), The adapted mind (pp. 19-136), New York: Oxford University Press.