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EXPERTISE VS GENERAL PROBLEM SOLVING ABILITIES IN HUMAN EVOLUTION
Reply to Overskeid on Brain-Expertise

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Abstract

In my target article (Skoyle 1999) I proposed that expertise, a domain dependent skill, was responsible for the near doubling of brain size in hominid evolution. Overskeid (1999) proposes instead that brain size is linked to two domain independent cognitive skills: problem solving and factual knowledge. My reply consists of two parts. First, I point out that domain independent cognitive skills are the product of modern education, technology, and culture, and hence irrelevant to understanding the cognition and evolution of premodern people. Second, I show that Overskeid's specific arguments against expertise are limited, and argue that he fails to provide an alternative.

Keywords

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

1. Overskeid (1999), whilst accepting most of my arguments, asks 'why expertise has been singled out as the prime explanation for our growing brains. Two other candidates that leap to mind are problem solving ability and the capacity to gather and remember factual knowledge' (Skoyles, 1999, para 1). My reply is divided into two parts. First, I note that Overskeid is proposing that domain independent skills (problem solving abilities, general knowledge) rather than domain dependent ones (such as expertise) were central to our evolution. This is an interesting conjecture. However, I show that domain independent skills are likely to be a recent historical innovation linked to modern education, technology and culture, and so irrelevant to understanding early humans and our evolution. Second, I detail the specific arguments made by Overskeid and find them for various reasons lacking in relevance and plausibility.

2. As a science, psychology tends to disregard the impact of recent educational, technological and cultural circumstances in shaping the human mind and its cognitive development. Indeed, of all the major sciences, it is only psychology which approaches its subject matter ahistorically. As a rule, professional psychologists and journals do not discuss the origins of the mind (most discussion of paleopsychology is done by nonpsychologists or those outside the mainstream), nor do they consider how far the processes they study are shaped by modern circumstances. Research into problem solving abilities, for example, assumes it is studying general processes (one of Overskeid's assumptions), even though the subjects of research are modern people, usually highly educated students. These processes are unlikely to be general to all people, however, since the subjects of research will be particularly adept and skilled at solving domain independent problems, as a result of their access to modern education, technology and culture.

3. Through modern education, virtually everyone is exposed from five years of age (and earlier in preplay-school) to constant implicit or explicit demands for problem-solving, in the form of toys, television programmes, course work, examinations, and other exercises which aim to develop abstract problem solving skills. There is reason to suppose that these activities are effective in developing abstract problem solving skills, as there is a high correlation between a person's IQ scores and the number of years of education they have received (Ceci, 1991).

4. When we are given a general problem to solve, we expect also to be given pen and paper, with which to sketch out preliminary approaches and results. Even if they are not provided, we have experience in mathematics and other areas of knowledge which will help us to solve problems in a general rather than a domain dependent way. Moreover, the technology of writing provides us with decontexualised experience of ideas, and research suggests that this helps us engage in decontexualised reasoning (Olson, 1995).

5. Modern concepts are mostly abstract, and therefore domain independent rather than concrete and domain specific. However, anthropologists have found that people in most premodern and nondeveloped societies used concrete number words when counting. That is, there was one word for one person, another for two people, three people, and so on. There may be another series for the various numbers of canoes, long objects, flat objects, round ones, and measures (Schmandt-Besserat, 1992: 184-187). Such concrete number words, it should be noted, are not completely absent in our own language, for example, they are used to identify groups of musicians - soloist, duet, trio, quartet and quintet. The role of concrete numbers in our reasoning is only small, however. Abstract nonmathematical concepts also appear to be recent: in Homeric language, as the Classical Greek scholar Bruno Snell observes, nine concrete verbs exist to describe sight, but none of them describes the abstract notion of sight as a function. Instead, they refer to concrete aspects of vision: to have a particular look in one's eyes; or a gesture that incites terror; or looking about carefully; or the feelings experienced in the act of seeing (Snell, 1953: 1-3). In the Greek language at least, abstraction began around two and half thousand years ago (Snell, 1953: 227-231). Hence many concepts used in modern domain independent problem solving were unavailable to premodern people.

6. The recent history of problem solving suggests that our capacities as problem solvers may be shaped by historically contingent factors. It has been found that abstract problem solving tasks used in many IQ tests such as the Raven progressive matrices have become very much easier for people during the last half century -- the Flynn effect (Flynn, 1997). While the reason for this improvement is not known, suspicion is focused on television and other optical displays which present complex visual problems (Neisser, 1997). If such effects can occur over fifty years, there is a considerable possibility that even greater changes have occurred from the beginnings of human evolution to the present day.

7. Cross-cultural research shows that where people fail to attend school, they acquire domain specific rather than domain general skills. This is the case with the mathematical skills acquired by poor children working as street traders in Brazil (Nunes, 1993). Despite their lack of schooling, such children solve the mathematical problems required to manage their inventory, measure products, calculate costs for customers, and provide change. These mathematical skills are domain specific: the children cannot transfer them for use in solving abstract "school" type mathematical problems.

8. The idea that premodern humans lacked general problem solving skills (rather than domain specific ones) is supported by the historical failure of humans to develop technologies of obvious utility, despite the fact that these have often been within their technological grasp. To take one of many examples: no American society prior to Columbus developed devices that used the wheel (Whitehouse & Wilkins, 1986: 106). This was not because they did not know of the wheel, since archaeologists have unearthed small effigy figures at Toltec and Aztec burial sites. It has been argued that many uses of the wheel - on vehicles, for example - would have been of little utility in ancient America, given its terrain and its lack of indigenous animals suitable for pulling vehicles (the llama was the largest available). This does not, however, explain the failure of ancient American people to invent such things as the water mill, pulley, winch, the

potter's wheel, or the wheel barrow. It is difficult to see how such innovations could have been missed if general problem solving abilities rather than domain specific ones were part of the cognitive skills of premodern industrial people. The more likely situation is that they were not, and that such skills have only developed in modern people, through the influence of such factors as modern schooling.

9. One can accordingly conclude that general domain independent solving abilities found in modern people are unlikely to be relevant to understanding human origins, as they are a modern and not an ancient mental phenomena.

10. Overskeid argues some specific points against the idea that expertise capacity was responsible for expanding the human brain. He correctly notes that expertise does not generalise outside the domain in which a person has spent several hours of focused practice each day for a minimum of ten years (Ericsson & Lehmann, 1996). The 50,000 chunks of knowledge (Gobet & Simon, 1996) that, for example, enable a chessplayer to develop a winning strategy, will not necessarily bring success at checkers, drafts, or other board games. While Overskeid is right to point out that expertise is not a general ability, he is wrong to suggest that those 50,000 chunks of knowledge could not create the skills needed for the survival of our early hunter-gatherer ancestors.

11. Expertise can be as general or as narrow as the problem space in which it is developed. If a person spends ten years practising not simply chess, but also checkers, drafts, and other board games, they will become expert (though with less depth of expertise) in these various games. Overskeid suggests that "expertise is for stable environments, but problem solving ability is for adapting to new and unknown circumstances" (Overskeid, 1999, para 3). But over a ten year minimum period of apprenticeship in the skills necessary for survival through simple hunter-gathering, early hominids would have been exposed to a wide variety of seasonal and annual climatic variations. This would have provided them with the generality needed for future survival.

12. Take prey tracking, the example I gave in my target paper (the similar comments also apply to the other areas of ancient expertise I mention, such as gathering, scavenging, social relationships, language, tool making, and passing on acquired skills and knowledge). Contrary to Overskeid's view, this skill is not acquired for a stable environment. The !Kung of the Kalahari desert of south-western Africa, like hunter-gatherers almost everywhere, face weather conditions which vary widely across the seasons (Lee, 1979). In December, for example, the land dries, and water holes become empty. Moreover, this climate varies widely on an annual basis: serious drought occurs in four out of ten years, becoming severe in one out of twenty years. !Kung therefore do not acquire an expertise for a stable environment; rather, during the minimal ten year period of their apprenticeship they learn a broad range of skills related to widely differing weather conditions.

13. Overskeid suggests that brain size might link to 'the ability to consciously remember large quantities of facts from a wide variety of areas' (Overskeid, 1999, para 7). It is difficult, however, to separate abstract factual knowledge from domain factual knowledge

acquired from expertise. This is particularly the case for people such as our hominid ancestors, who lived prior to the technologies and role specialisation that enabled the storage of facts independent of experience [NOTE 1]. The idea of domain independent factual knowledge is reflected in the existence of such things as encyclopaedias, and the fact that we take part in activities such as quiz shows and examinations, in which facts are retrieved and stored merely to demonstrate our ability to retrieve and memorise information. How far can we generalise our experience of factual knowledge to people who have no means of storage other then their own experience and no concerns other than immediate practical problems? As with domain independent problem solving abilities, I would suggest such domain independent memory skills are historically modern, and therefore irrelevant to understanding the domain dependent processes of premodern people.

14. Overskeid further provides a rationale for the usefulness of facts against practical experience for survival, and suggests, that "to some extent, factual knowledge can make up for the many years of task-specific practice that is a prerequisite of expertise" (Overskeid, 1999, para 8). Is this really true? Can factual knowledge substitute for the expertise which comes from experience? Does Geir Overskeid seriously believe that if he read up on the facts about wildlife and survival skills needed for life in the Kalahari desert, he could use them to live for more than a few hours if left there without the assistance of modern technological aids such as water bottles, four-wheeled jeeps, cloths, canned food, tents, and maps? In a practical context, knowledge gained from books cannot substitute for knowledge gained through experience, neither for modern people, nor for our Paleolithic ancestors.

NOTES

[1] Storage technologies include not only those enabled by print but the specialisation of oral skills to preserve ancient knowledge found in such societies as India.

REFERENCES

Ceci, S. J. (1991). How much does schooling influence general intelligence and its cognitive components? A reassessment of the evidence. Developmental Psychology, 27, 703-722.

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.

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.

Flynn, J. R. (1997). Massive IQ gains in 14 nations: what IQ tests really measure. Psychological Bulletin, 94, 29-51.

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

Neisser, U. (1997). Rising scores on intelligence tests. American Scientist, 85, 440-447.

Nunes, T. (1993). Learning mathematics: Perspectives from everyday life, In R. Davies & C. A. Maher (Eds.), Schools, mathematics, and the world of reality (pp. 61-78). Boston: Allyn & Bacon.

Olson, D. R. (1995). The world on paper. Cambridge: Cambridge University Press.

Overskeid, G., (1999) Factual Knowledge And Problem-Solving Ability: Not Expertise, But Perhaps Still Related To Brain Size. Commentary on Skoyles on Brain-Expertise. PSYCOLOQUY 10(002) ftp://ftp.princeton.edu/pub/harnad/Psycoloquy/1999.volume.10/ psycoloquy.99.10.011.brain-expertise.2.overskeid http://www.cogsci.soton.ac.uk/cgi/psyc/newpsy?10.011

Schmandt-Besserat, D. (1992). Before writing: Vol 1: From counting to cuneiform. Austin: University of Texas Press.

Skoyles, J.R. (1999). 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

Snell, B. (1953). The discovery of the mind: The Greek origins of European thought. Oxford: Blackwell.

Whitehouse, R. & Wilkins, J. (1986). The making of civilisation. London: Collins.