Attention Deficit Hyperactivity Disorder: An Evolutionary Perspective

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ABSTRACT. Attention deficit hyperactivity disorder (ADHD) affects a significant portion of the population—some 5% of all school-aged children—and approximately half of these individuals continue to show the full disorder in adulthood. Recent studies point to a strong genetic component in the etiology of this disorder. Questions have been raised as to the relatively high prevalence of this condition in the population, given its apparent maladaptive nature in present-day society. In this article, we review and discuss three theories regarding the possible adaptive function of ADHD: the hunter, fighter, and wader theories. Although no theory entirely explains the occurrence of ADHD, it is worthwhile to note that, at least historically, ADHD may have served an adaptive function and may have been selected by the environment for survival.

ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD) causes individuals to display a behavior pattern that is significantly different from normal and is correlated with poor adult outcomes in the areas of social skills, organizational ability, job success, and criminal involvement, among other problems (Barkley, 1990). ADHD affects a significant percentage of the population: some 5% to 6% of school-aged children present with ADHD (Barkley, 1990). Of these individuals, 30% to 60% continue to display significant ADHD symptoms in adulthood (Weiss & Hechtman, 1993). Evidence also exists that ADHD has a strong genetic component (Barkley, 1990; Comings, 1994a; Cook et al., 1995; Phelan, 1993).

Recently, ADHD has been viewed by some authors as perhaps having had beneficial qualities in our evolutionary past as well as in current Western culture (Hallowell & Ratey, 1994; Hartmann, 1993). Among these are creativity, high energy, and willingness to take risks. This is a dramatic departure from viewing

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ADHD only as a set of behaviors that are disruptive to academic, social, and career success (Barkley, 1990; Matson, 1993; Weiss & Hechtman, 1993). An analysis of ADHD as having both maladaptive and adaptive qualities may provide insights into its prevalence and allow for a new perspective for viewing the disorder. In exploring the issues of the genesis and possible current utility of ADHD, we review the clinical parameters of the disorder and discuss theories of the reasons for the development of ADHD as a prevalent disorder.

Clinical Features

Attention deficit hyperactivity disorder is the most recent in a long list of labels applied to individuals with a distinct cluster of symptoms that begin in early childhood and often persist into adulthood. Precisely what symptoms best define this disorder has been a point of contention since the beginning of this century, and the criteria are constantly being refined and modified by clinicians and researchers. Currently, most in the field agree that the primary ADHD symptoms include inattention, impulsivity, and hyperactivity (Matson, 1993).

Recently, Barkley (1990) defined ADHD as an “inherited or induced biological condition” with the following symptom cluster: poor sustained attention and vigilance, impulsivity and poor delay of gratification, hyperactivity and poorly regulated activity, diminished rule-governed behavior, and increased variability of performance. The results of this disorder vary widely, but increased parental and peer rejection and overall negative treatment often lead to the development of aggression. The majority of negative outcomes, including behavioral disorders, substance abuse, and jail time are all correlated with high levels of childhood aggression (Baker, 1995; Barkley, 1990). Aggression constitutes the most problematic component of social maladjustment for these individuals.

Research on children who displayed these symptoms at a level inappropriate for their biological and mental age has led to theories that have governed research and clinical interventions for the last 30 years (Hartmann, 1993; Weiss & Hechtman, 1993). Most recently, factor analysis has indicated that the clinical symptoms may best be grouped into two clusters: inattention and hyperactivity/impulsivity (Barkley, 1990). These clusters and other findings have resulted in the abandonment of previous diagnostic systems in favor of a two-symptom cluster system (see DSM-IV, American Psychiatric Association, 1994).

Biology of ADHD

As we move toward understanding reasons for the persistence of ADHD in the gene pool, it is important to establish its biological/genetic etiology. Although environmental factors do influence the course of ADHD over a lifetime, there is agreement among researchers that the characteristic problems of people with ADHD stem from neurobiological malfunctioning (Hallowell & Ratey, 1994).
Although it is difficult to pin the pathogenesis of the disorder on one specific system, there is a growing amount of evidence that ADHD is rooted in the processes of the cerebral cortex and some subcortical structures. The role of genetics in producing these neurological conditions must often be inferred but is becoming increasingly clear.

The work of Chelune, Ferguson, and Richard (1986) and of Lou, Henriksen, and Bruhn (1984) supports frontal lobe underactivity as highly correlated with ADHD. The limbic and pre-frontal regions, along with thalamic contributing regions to frontal activity, are implicated as well. Frontal underactivity has face validity as a biological correlate to ADHD in light of the known function of this region (attention, impulse control, and social interaction regulation, among others) and as evidenced by the behavior of patients with frontal lobe damage, which can mirror ADHD in many cases. The combination of PET scan, cerebral blood flow (CBF) measures, EEG, and other studies of brain damage creates a strong picture of ADHD as a disorder based in the frontal lobe; however, elements of causality have yet to be teased out (Hallowell & Ratey, 1994).

Genetic studies point to a rare thyroid dysfunction as one cause for ADHD (Hauser et al., 1993). In their research, Hauser et al. noted that mutations in the gene coding for the human thyroid receptor were significantly correlated with hyperactive/distractible behavior. This finding demonstrates another instance of a localized biological abnormality as the cause for ADHD-like symptoms in at least some individuals with ADHD.

To date, the most convincing evidence of a genetic component for ADHD comes from Stevenson (1991). Stevenson used 91 pairs of identical, same-sex twins and 105 pairs of fraternal, same-sex twins selected from London hospital records to demonstrate a strong heritability component. Multiple regression analysis was used to confirm that the heritability of extreme group membership was significant for activity, as rated by the mother, and that heritability for attention deficit was also significant. In other words, these results indicate that there is a significant genetic contribution to individual differences in activity levels and attention abilities.

Further support comes from the research of Gillis, Gilger, Pennington, and DeFries (1992), who used regression analyses of scores obtained on the Diagnostic Interview for Children and Adolescents to compare identical and fraternal twins' heritability component for ADHD. These researchers found that "ADHD is highly heritable." The work of Comings (1994a) on sexuality and ADHD and on alcohol abuse and ADHD (Comings, 1994b), and Faraone, Biederman, and Milberger's (1994) work on comorbid disorder exclusion all point to a heritability factor for ADHD as well.

Comings (1994b) proposed that a site on the D2 gene coding for one type of dopamine action is likely to be a cause of ADHD and related syndromes. This research stems from similar studies attempting to link ADHD with other disorders of inhibitional control, including Tourette's syndrome (Comings, 1994a,
1994b), ADHD is present in 49% of all patients with Tourette’s syndrome, and up to 50% of all children with ADHD have chronic tics or a family history of chronic tics. On the basis of clinical interviews, Comings (1994b) deduced that ADHD is part of the primary expression of the Gilles de la Tourette gene. Criticism of this hypothesis has prompted Comings to acknowledge that the D2 gene may be only a moderator for the expression of some more central gene group (Hallowell & Ratey, 1994).

Finally, a recent study by Cook et al. (1995) indicated a strong genetic link between ADHD and dopamine processing. Forty-nine children with ADHD and their parents were studied. Results indicated a significant association between ADHD and the dopamine transporter gene.

**Evolutionary Persistence of ADHD**

Thus, research suggests that there is a genuine genetic component for ADHD symptoms. What is not known, however, is why these traits have persisted as part of the gene pool. ADHD is a significant disorder, affecting at least 3.5 million children—about 5% of the general population of school-aged children (Barkley, 1990). How could it be that the disposition for such a damaging disorder exists in such a large number of individuals? From a Darwinian perspective, one possibility is that it must have had some survival value during our evolutionary history.

**The Hunters**

One way to view the prevalence of ADHD as a genetic phenomenon has been proposed by Hartmann (1993). In his book *Attention Deficit Disorder: A Different Perspective*, Hartmann proposed that ADHD traits were selected because they were valuable for the survival of the pre-agricultural human. He suggested that the traits of distractibility, impulsiveness, and even aggression would have been directly useful to a hunter. For example, Hartmann wrote, “If you see a flash in the darkness, or an object move from the corner of your eye, it is likely either potential food or a predator.” Hartmann went on to distinguish between the ADHD population—the “hunters”—and the non-ADHD population—the “farmers.” This distinction was based on Hartmann’s first-hand accumulation of hundreds of anecdotes and on his observation that many of the traits displayed by hunters, in primitive and modern societies alike, seem to overlap with those of the ADHD individual.

Hartmann (1993) stated: “When the condition (ADHD) is so widely distributed (above the mean), inevitable questions arise: Why? Where did ADD come from? The answer is: people with ADD are the leftover hunters, those whose ancestors evolved and matured thousands of years in the past in hunting societies” (p. 13). For Hartmann’s ideas to have any validity, our ancestors had to have been
hunters, and the traits he described had to have been powerful enough to act as a force for natural selection.

Hartmann (1993) offered this summary of the traits of the hunter: They constantly monitor the environment. They can totally throw themselves into the hunt; time is elastic. They are flexible, capable of changing strategy at a moment's notice. They can throw an incredible burst of energy into the hunt but may not have great staying power. They think visually. They love the hunt but are easily bored by mundane tasks. They will face the danger that a "normal" individual would avoid. They are hard on themselves and those around them.

Strangely, Hartmann offered no studies supporting the validity of his collection of traits. This list seems to represent a commonsense appraisal of traits that are thought to be possessed by hunters and so presumably were always expressed by hunters. Anthropologist Desmond Morris (1967), on the other hand, indicated in *The Naked Ape* that primitive hunters must display stealth, concentration, silence, and a keen sense of the awareness of their environment. It may be that Hartmann developed his criteria for hunters on the basis of his observations of many ADHD individuals, but not on many hunters. The real, clinical symptoms of hyperactivity, impulsivity, and inattention may not be displayed by hunters at all.

Traits developed over countless millennia would be slow to fade from the gene pool without serious pressure to do so. In other words, if ADHD is part of a primary adaptation to a hunter-gatherer lifestyle that prevailed for at least 1.1 million years, since the era of our ancestor Homo erectus, then it would remain in an overwhelmingly large portion of modern people, unless some factor made ADHD suddenly highly detrimental for continued reproductive success. Modern studies indicate that only 5% to 6% of the school-aged population has ADHD, hardly a majority, so the action of some force is indicated. Hartmann proposed that agriculture is this force. Two problems exist with this theory: the first is the assumptions that Hartmann makes about the cultural milieu in which premodern humans lived, and the second is the problem of the time frame for genetic change.

Many theories have been put forth to describe the nature of early human societies. Anthropologists agree that early humans (from 100,000 B.C. to the start of Neolithic times) aggregated in small groups that would travel nomadically over a partially set range. Evidence exists that hunting did play a role in the lives of these groups, but the extent is unclear. Hartmann may have fallen victim to a common Western myth for explaining many of the behaviors of modern humans: that of "Man the Hunter."

*A Myth?*

The popular myth of man the hunter has dominated anthropological thought since the time of Darwin. This myth was propagated not only because it bolstered the egos of the predominantly male scientific establishment but also because it appealed to the dominant sentiment that because "man descended from the
brutes,” the farther back in time one looks, the more brutish behavior one will find. Also, the theories of human evolution that dominated until the middle of the current century were integrally tied to the idea of man as a hunter.

The first issue, that man as a hunter appealed to the scientific establishment, is now fairly well accepted. Morgan described this sentiment in The Descent of Woman (1972) by saying that men have sought a biological, and therefore uncontrollable, cause for their aggressive behavior. This attitude stood as the vestigial remains of a Victorian scientific attitude that helped to contribute to Social Darwinism, on the racial front, and to the variability hypothesis of women’s innate lack of potential, on the gender front (Viney, 1993). A circular form of logic prevailed: Men must have been, and still should be, dominant because they were hunters, and they must have been hunters because of the dominance and aggression that they display now. Images such as the Wall Street “shark” and the caver dragging home his bride by the hair are all derived from man as hunter, woman as baby maker.

Also, an anthropocentric bias tinted scientific attitudes in the past. Alfred Russel Wallace, co-developer of the theory of evolution with Charles Darwin, concluded that “a superior intelligence has guided the development of man in a definite direction, and for a special purpose” (Leakey & Lewin, 1992). So disturbing were the implications of evolution that it became necessary to search for special characteristics that created a dichotomous and uncrossable fissure between humans and animals. Even though evolution placed humans as animals, descendants of the primates, scientists were as unwilling to fully accept these implications as the general populace was. But the idea of man the hunter was not merely an irrational safety net designed to prevent too close a relationship between man and the animals from being postulated.

One theory of human evolution postulated hunting as an integral, causal mechanism for human evolution. Protohuman species are known to have existed in the patchy savannah environment of Pliocene Africa, some 3 to 12 million years ago. Some have hypothesized that the growing scarcity of food sources caused a split in human evolution, or adaptive radiation, in which the entirely fruit-eating protohumans divided into one group of hominoids that became dedicated herbivores and another that became omnivores. Humans are thought to be the descendants of the latter. As humans began to eat more meat, they slowly changed from passive scavengers to tool-using hunters. In this way, tool making—especially the making of weapons—offered a selective advantage. Those who could walk better over greater distances could have access to more food, and those who could carry a weapon could obtain more food, because one must have a hand free to carry a weapon.

This line of reasoning has fallen out of favor somewhat. Tool making occurs much later in the fossil record than does bipedalism, by millions of years. Moreover, even with the advent of the first tool technologies, humans were probably poor hunters. The rough quality of the stone scrapers and choppers that make up
our technological past indicate that humans were at worst "marginal scroungers" and at best supplemental hunters (Leakey & Lewin, 1992). Modern supplemental hunters, such as bushmen, rely on plant matter for the majority of their diet, and hunting is not an integral part of their society. Tribes may go entire seasons without the supplemental nutrition of flesh (Harris, 1974). In fact, modern anthropological surveys indicate that very few of the remaining pre-agricultural societies in the world rely on hunted game for their sustenance, except those that live in extreme conditions, such as the northern Inuit (Harris, 1974).

The probability is therefore low that hunting was either the center of life for early humans or acted as a selective mechanism for survival. Thus, it seems unlikely that any trait, including those associated with ADHD, would be the result of a hunting lifestyle. Yet, if ADHD occurred only recently as a cluster of traits, it might be possible that the forces acting on Homo sapiens in the past 100,000 years, the time period when humans were thought to be the most intensive hunters, could have caused ADHD to offer an advantage. In this light, though, ADHD must have descended to its current status of 3% to 5% of the population equally as quickly.

The Fighters

In the current cultural setting, those with ADHD are more likely than most to develop aggressive behavior (Barkley, 1990). The high-energy, active behavior associated with ADHD also elicited aggression early in the history of humans as well. One situation in which aggression has been proposed to have been useful was summarized by Leakey and Lewin (1992). Recent paleontological and anthropological discoveries have indicated that Neanderthal humans are not our predecessors but that they represent the last in a long series of parallel evolutions of hominoids. The extinction of Homo Neanderthalis appears to have been caused by Homo sapiens, but there are two possible explanations as to how. The first is that Homo Neanderthalis was indirectly out-competed in a struggle for resources, and because Homo sapiens had a slightly higher rate of reproduction, they, in effect, "crowded" Homo Neanderthalis out of existence.

Alternatively, Neanderthals may have been slaughtered by Homo sapiens migrating northward from Africa into the European continent. Archeological evidence indicates that Neanderthal technology was not comparable with that of the Homo sapiens living at that time or even earlier (in Africa and the Middle East). As the African sapiens pushed northward, they would have been in direct competition with the Neanderthals for access to food supplies. As has often been the case, this conflict over resources could have led to war. In this case, a fierce, energetic human with reduced inhibitions would have been ideal.

Recently, in our society, children with hyperactivity have been treated with stimulants, special classrooms, and special programs. Imagine the child whose hyperactivity was cultivated, and whose natural tendencies to be impulsive and
possibly aggressive were magnified. We see some indication of the results of this sort of process now, in the American prison system. It has been estimated that as many as 90% of those in jail currently have hyperactivity, and over 60% could have full-blown ADHD (Baker, 1995). Those individuals whose environments did encourage aggression, either through modeling or through the larger cultural setting, do appear to develop those "criminal" traits that would be advantageous in a society engaged in a genocidal war: Impulsiveness, reduced inhibitional control, and even a reduction in focused attention could be explained as the results of constant immersion in a battlefield setting.

The Waders

Aggression has figured highly into these views of the ADHD person as a hunter or fighter. Another scenario, in which the traits of ADHD could have been advantageous, but that does not necessitate an increased level of aggression, was developed by Morgan (1972), in the Descent of Woman. Her theory is that humans underwent the major portion of their evolutionary transitions from quadrupedal to bipedal, from atechnological to tool makers, and from mute to linguistic as a result of being tidal waders. This theory is known as the aquatic ape theory. Morgan pointed out that humans possess many biological signs of no longer useful systems, just as ADHD symptoms are not currently useful to our survival. Among these systems are an extra layer of body fat, partially webbed feet (which can occur in up to 3% of the population), and salt-securing tear glands, of which only aquatic mammals have need.

If this theory is correct, it offers several clues about the origins of ADHD. First, Homo sapiens are the only primates with the absence of significant body hair. This has been hypothesized as a result of the streamlining and drag reduction that takes place in all mammals that enter the water, such as whales and dolphins. The hunter theory of human evolution describes hair loss as a cooling adaptation for long-distance running. This would make sense, except that humans are the only primates that have added a thick layer of subcutaneous fat recently in their evolution, and this layer is not conducive to cooling. This fat is also thicker on women than on men, an adaptation that would make sense if women spent more time in the water, presumably for protection from land predators.

Without body hair on the mother, human infants are unable to use the primary survival mechanism for young primates: clinging to the mother. In every hominoid species, except human, we find young clinging to the mother by body hair for protection and as a means to access the mammary glands. In humans, these glands are much larger than in any other mammal, except for the manatee (another aquatic mammal). But larger glands alone do not ensure adequate feeding for the young human. The mother must deliberately hold and position the neotenous young in order for it to feed. The young with the higher ability for initiating maternal attention could be the one more likely to survive.
This behavior is what we see in individuals with ADHD. Barkley (1990) indicated that unmedicated children with ADHD instigate more contacts with their mothers than do comparable non-ADHD controls. Barkley also reported that mothers initiate more verbal contacts with their ADHD children. Along with this, mothers of children with ADHD initiate more controlling, physical contacts with their children than do mothers of non-ADHD children. All of these effects lessen under stimulant medication, so they may be said to be caused by the child’s ADHD symptoms with some certainty. Although in the current social milieu these behaviors emerge as maladaptive, in the context of a tidal society with a slippery, changing environment they could prove useful.

In this marine world, hand signals, basic body language, and accompanying vocalizations would not be effective. The hands would be needed for swimming and for stabilization against the tide, and body language would be largely invisible to others. For this reason, it may be that complex vocalizations developed. The hunter explanation for speech development, which postulates that verbalization developed as a means to relay increasingly complex strategies and flexibility on the hunt, is flawed. Research shows that existing hunting societies use very few verbal commands, relying on hand signals to direct the group’s operations, for the simple reason that noise scares away game (Morgan, 1972). But in the marine environment, the vocal apparatus would be vital for survival.

It is common for children with ADHD to hypervocalize (Barkley, 1990; Phelan, 1993; Weiss & Hechtman, 1993). What is viewed today as maladaptive, because it often leads to negative responses from peers and teachers (Olencak, 1995), would have provided a distinct advantage in a tidal setting. Imagine the advantage of producing more active speech than your peers: your position would be constantly monitored by others, you would cause the adults in your group to pay an inordinate amount of attention to you, and, in times of danger, everyone in your group would be acutely accustomed to your particular speech pattern and could locate you more quickly.

These theories are based, in part, on the simple notion that “the squeaky wheel gets the grease” or that any individual with atypical behavior is likely to get more attention. We find that modern children with ADHD do get more attention, although in Western culture, most of this attention is negative. In this early tidal society, persistence of ADHD behaviors in childhood may have elicited some, but not as many, negative reactions, and these reactions may have been outweighed by the adaptive aspects of ADHD for this wader society.

**Conclusion**

Some possible scenarios for the evolutionary development of ADHD as an advantageous condition have been suggested, and we hope that this article will prompt further discussion of this concept. Because children with any disorder are often stigmatized and may suffer damage to their self-esteem and confidence as
a result, any model that reconceptualizes a disorder as having potential benefits may serve to instill pride in those with the disorder and lessen the feelings of disability. The hunter, fighter, and wader theories remain good models for conceptualizing ADHD as a disorder that represents a poor fit between the individuals' characteristics and the current, but not all, environments.

REFERENCES


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