EVOLUTIONARY DEVELOPMENTAL PSYCHOLOGY AND PEDAGOGY

Animal Training:

Evolutionary Developmental Psychology and Pedagogy

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Evolutionary Psychology

Humans, like every extant organism, plant, and animal, have evolved special features and genetic functions to foster its adaptation and reproductive fitness to its environment. In this light, we differ from Darwin's Galapagos finches and Wallace's flying frogs in degree, but not in kind. However, a distinction must be made for human's evolved communicative and cognitive system, one that is uniquely complex and permits the explicit, self-aware representation and transmission of knowledge (Bjorklund and Bering, 2002).

Human's self-aware process of learning and the passing of new knowledge have in turn allowed us to develop an understanding of how we have evolved, both physically and psychologically. The central claim made by the relatively young discipline of evolutionary psychology is that our minds were designed by natural selection to maximize reproductive fitness in the *environment of evolutionary adaptedness*—in simpler terms, the ancestral environment—dating from 1.8 million to 10,000 years ago (Cosmides and Tooby, 1987). Most forms of human and animal cognition rely on the neurobiological systems that have evolved to serve a survival or reproductive need in a particular environment (Geary, 1995). According to Pinker (1997), the mind is organized into modules of psychological mechanisms, each with

a specialized design that makes it an expert in an area of interaction with the environment. Through an *adaptationist* perspective, evolutionary psychologists see these modules of the human mind as knobs that present itself during ontogeny, ready to be tuned by the proper environmental cue (Wright, 1995).

Evolutionary Developmental Psychology

Within this framework of emerging inherited and yet plastic mechanisms during the course of an individual's development, Bjorklund and Bering (2002) have defined evolutionary development psychology as

> the application of the basic principles of Darwinian evolution, particularly natural selection, to explain contemporary human development. It involves the study of the genetic and environment mechanisms that underlie the universal development of social and cognitive competencies and the evolved epigenetic (gene—environment interactions) processes that adapt these competencies to local conditions (p.3)

This is not a form of genetic determinism; evolutionary development psychology posits that development progresses similarly for most individuals because children inherit not only a species-typical genome, but also a species-typical environment. All products of evolution have evolved to expect a certain condition in the environment, and for humans, this would include nine months in a sheltered womb, an affectionate and protective mother, kin to provide additional support, and after some maturation, mates and competitive peers (Bjorklund, 2007).

Moreover, a study developed by Gottlieb (1991, 1997) shows that even "instinctive" behavior, traits that were purportedly inherent in the genome, requires the species-typical embryonic experiences for the traits to be activated. In his experiment, ducklings devocalized by a procedure while still in their eggs were isolated from their mothers or any other pre-hatchlings. As a result, the test subjects did not once hear the vocalization characteristics of their own species. Once hatched, the ducklings were placed in a circular container, with speakers on both sides. One played the maternal call of their own species, and the other the call of another species. The control group—ducklings with species-typical environment of hearing the vocalizations of their own species—approached the maternal call of their own species. However, Gottlieb's test subjects showed no significant preference for either call. The experiment forcefully evidences the importance of species-typical environment in the subsequent development species-typical psychological and behavioral traits.

Piaget and Cognitive Developmental Theory

The understanding that species-typical traits, particularly the aptitude of human learning, are not universal among species but are dependent upon the transactions between genetic and environmental factors, is a core tenet of developmental and educational psychology. A starting point for any discussion on cognitive development or constructivist pedagogy, Piaget's cognitive developmental theory has shaped our understanding of how individual's cognition changes in

predictable ways. Piaget's central claim made in 1958 is the idea that children are able to solve certain problems only at certain ages, and that these cognitive challenges can be organized into a developmental sequence that defines discrete states of cognitive development.

Piaget's approach has served at the basis of most contemporary educational policies. It is now well documented that children across cultures accomplish certain tasks approximately at the ages and in the stages predicted (cited in Genovese, 2003). However, several important elements of Piaget's work have not withstood to contemporary empirical scrutiny. Evidence shows that Piaget has underestimated the capacities of infants (Omrod, 2003, cited in Genovese), and Piaget's model of unified stages does not always account for the accumulated and uneven development of children's cognition. In addition, it is now evident that many teenagers and adults do not reason in the ways characterized by Piaget in the formal operations stage (Genovese, 2003).

Formal Operational Stage

Piaget's stage of formal operations is the single stage in his sequence having the most profound implications for education (Kuhn, 1979, cited in Genovese). The formal operational abilities include prepositional logic, inductive logic, hypothesis testing, and reasoning about proportions, combinations, probabilities, and correlations. Piaget believes that younger children cannot disregard the content of an argument and pay attention to its formal structure. If given the following

syllogism,

God loves all people,

Gays are people,

God loves Gays

Piaget would argue that the younger children will respond to the context but the adolescent can follow the argument because of its sound logic. However, a study by Morton and Morton (1944, cited in Genovese) found:

> that even when a subject is presented with a syllogism in which the terms are abstract symbols or concrete terms which have little or no personal significance, he has difficulty in selecting the correct conclusion. When the content was personally significant they found that distortion becomes much more marked when the terms in the syllogism are related to the personal conviction of the reasoner. A person is likely to accept a conclusion which expresses his conclusion which expresses his conviction with little regard for the correctness or incompleteness of the inference involved.

Reflecting on Tamburrini's (1982) claim that there is considerable evidence that formal operational thought is contextually bound, Genovese (2003) states, "This is no small concession; the very point of formal operations is that they go beyond context and content. The failure of adolescents and adults to reason in the ways predicted by Piaget is a serious problem for both the theory and practice of education, for it is precisely the formal reasoning skills that are necessary for

mastering academic subjects such as math and science beyond the elementary level (p.130)." It is now evident that Piaget's stages of cognitive development are non-universal. Formal reasoning skills have not developed reliably even in humans whose developmental environment is species-typical.

Evolutionary Educational Psychology

Genovese (2003) concludes that our education policies were created under faulty premises within the scope of cognitive developmental psychology. He logics that evolutionary developmental psychology, on the other hand, provides educators with a framework to understand the frequent failure of adolescent and adults to use formal reasoning and master certain academic tasks. In a groundbreaking paper, Geary (1995) draws a distinction between *biological primary abilities* and *biologically secondary abilities*. This distinction also serves as the underlying principle under which the central debate within the field of evolutionary educational psychology is based upon: *Should instruction of the evolved mind be explicit and teacher-directed, or discovery-oriented and student-centered?*

Biologically Primary and Biologically Secondary Abilities

Consistent with the evolutionary psychology approach of finding similarity in children developments within species-typical environment, Geary (1995) suggests that natural selection has provided all children with sets of cognitive abilities that would be useful across the world in any time period. These skills are universal in their acquisition and use, and because of their immediate impact on survivability,

children display an intrinsic motivation to learn and display them, in many instances spontaneously. In addition to innate preferences such as filet mignon over feces (Bjorklund and Bering 2002), counting small sets of items, simple arithmetic, and human language are all examples of what Geary (1995) refers to as *biologically primary abilities*.

In contrast, *biologically secondary abilities* were evolved for specific cultures and are not universal by definition. These are more complex cognitive operations co-opted from a neurocognitive system that was designed for another evolution-based function. For example, the biologically secondary ability of reading requires the co-optation of biologically primary skills such as language and visual scanning (Luria, cited in Geary, 1995). In math, the biologically secondary ability of understanding geometry is built upon the implicit skeletal principle of spatial awareness, a biologically primary ability. And because biologically secondary abilities do not serve an immediate purpose in survival or reproduction, children are much less motivated to learn and practice these more complex sets of skills. The difference in value between a biologically primary ability and a biologically secondary skill in the ancestral time is obvious. Consider the following examples: The biological primary skill of verbal communication allows our ancestors to transmit warnings of nearby predators, but the biologically secondary skill of reading can serve no immediate purpose in the ancestral environment. In addition, the biologically primary ability of counting enables the ancestral human to expend his energy on gathering the larger, and thus, worthier pile of fruits, but the biologically secondary skill of calculating

weight distribution cannot be advantageous in a time without the need for architecture. The evolved mind is not designed for learning the complex cognitive skills of the present-time, and evolutionary psychologists such as Geary (2002) argue that biologically secondary abilities must be taught, and extrinsic motivation is often necessary. In fact, a closer examination of modern culture reveals that even educated adults rarely read or solve geometry problems.

Explicit Direct Instruction

This simple dichotomy suggested by Geary holds vast implications for modern education. The bank of human knowledge has become increasingly complex, and children can no longer acquire the innumerable biologically secondary abilities required to navigate through modern culture simply through play or by watching and doing. Biologically secondary abilities such as reading, writing, mathematics, history, art, science, basic technological skills, among other context-independent knowledge, are by definition unnatural, and Geary (2007) contends that unnatural and learning methods are precisely what the evolved mind requires for the efficient acquisition of such sets of complex information. Despite agreeing with the fact that children did not evolve to sit quietly in age-segregated classrooms to be lectured by unrelated adults, Geary makes clear that such procedures are necessary. He (2007) further argues, “Children will not be sufficiently motivated nor cognitively capable to learn all of secondary knowledge needed for functioning in modern societies without well organized, explicit and direct teacher instruction (p.26).”

Drawing from a model developed by Siegfried Englemann and Wesley Becker in the 1960's, Berch (2007) describes Direct Instruction (DI) as "explicit and systematic instructional formats based on scripted lesson plans, flexible skill grouping of students, brisk pacing of instruction, sequencing of skills, teaching to mastery, recurrent assessment, error correction, and the use of positive reinforcement." He also makes a distinction between DI programs that have undergone rigorous standardization and field-testing, and teacher-made lessons based on more generic versions of direct instruction (di). Direct Instruction, in essence, is an educational system that calls for the expert teacher to model learning and provides ample opportunity for the student to practice and drill until the desired outcome is reached.

Geary (2007) also argues that the superiority of the Direct Instruction approach is largely due to the ineffectiveness of student-centered learning, or discovery-based learning. He cites this type of learning as a by-product of the romanticizing of education, based on the assumption that a continuity of motivation will allow children to make the natural transition from primary learning to secondary learning. Geary (2007) proposes that it is an educationally fatal flaw to assume children will inherently be motivated to engage with secondary materials. Even if provided all the necessary components to learning—teacher, content, and environment—most children cannot be depended upon to self-motivate and engage in rigorous learning at the secondary level.

Discovery-Oriented Learning

Not all evolutionary psychologists agree on the merits of Direct Instruction. Positing from the other end of the spectrum, Gray (2004) suggests that the human mind have evolved to use play and exploration for the purpose of education, and this system has been so well-designed by evolution that it is still applicable in today's complex world. He further suggests that if educators can provide settings that optimize children's opportunities for play and exploration, children would not need the coercive methods of Direct Instruction for learning.

To survive and reproduce successfully, our ancestors must learn an enormous amount of knowledge without explicit teachings. Extrapolating from studies of hunter-gatherer societies in isolated parts of the modern world, Gray (2007) observes:

> To become hunters, boys must learn how to identify and track the two or three hundred different species of birds and mammals that their group hunts. They must learn how to craft the tools of hunting, such as bows and arrows, blowguns and darts, snares, nets, and so on. And, of course, they must develop great skill in using these tools. To become gatherers, girls must learn which of the countless varieties of roots, nuts, seeds, fruits, and greens in their area are edible and nutritious; when and where to find them; how to extract the edible portions; and how to process them. In addition, all hunter-gather children must learn to build huts, make fires, cook, fend off predators, predict weather changes, navigate their hunting and gathering grounds, treat

> wounds and diseases, assist birth, care for infants, maintain harmony in the group, negotiate with neighboring groups, tell stories, make music, and engage in the various dances and rituals of their culture. (p.20)

Hunter-gatherer children did not attend formal schooling; they were not instructed to drill and practice to prepare for tests and exams in an age-segregated setting. How did hunter-gatherer children learn such vast amounts of information? Gray (2007) attributes their learning to play and exploration. Little productive work is expected of children and adolescents of hunter-gatherer tribes, and they have an enormous amount of free time to play and explore as they please. As play, children spent countless hours mimicking their adult counterparts: digging up roots, cooking, using and making tools, building rafts and forts, pretending to hide and escape from predators, imitating animals (to learn their behavior), and even using bows and arrows to shoot insects before they graduate onto killing real game. The human nature strives to attain control of its surroundings, and evolution uses play to motivate and entice children to learn ways to reduce variables in the living environment.

Sudbury Valley School

Countering any arguments that suggests the information learned by hunter-gatherer children are only biologically primary skills, Gray (1986) provides 25 years of observations from his studies at the “radically alternative” Sudbury Valley School. The school is composed of 200 non-

selective mixed age students, 10 teachers, and a completely democratic administration. A voting process dictates all school decisions—including the hiring and firing of staff members and the legislation of school policies—with students and teachers alike each having one vote. The school believes that today's children, like hunter-gatherer children of the past, educate themselves best when allowed to freely pursue their own interests. Staff members at Sudbury High School respond to students' questions and requests for help, but their role is not to direct, motivate, or evaluate students' learning.

Literacy and numeracy dominates the modern life, and Sudbury children often learn such skills in games involving reading, writing, and numbers. In play, modern children mimic doctors and mechanics as opposed to hunters and gatherers. Students may unknowingly learn the basics of arithmetic when they conduct a game requiring currency transactions or keeping scores. Gray (2007) further infers that the freedom to learn through playing allows each student to repeatedly practice and become proficient at activities that interests them, fostering a passion to pursue a career.

Follow-up studies have revealed that Sudbury graduates continue on to happy, successful, and meaningful lives (Gray & Chanoff, 1986). Among them are successful artists, musicians, IT specialists, and mechanics who developed their love and skill through play with music instruments,

computers, and building models at Sudbury Valley school. Those who have chosen to pursue higher education have had no apparent difficulty getting accepted and performing well at esteemed colleges and universities. Collectively, the graduates have been successful in the whole spectrum of careers that our culture values (Gray, 2007).

Conclusion

Evolution provides us with a blueprint to our inherent biases and preferences in everyday functions such as learning, and our collective knowledge passed down from one generation to the next lays the foundation for future developments and discoveries. In this sense, education is then the social enterprise that links the past to the future, and its importance cannot be overstated. Education is now in dire need of immediate major surgery, but it would be wise for educational policy makers to first diagnose the reasons behind its failure with the latest scientific studies and research, including those that may lead us further away from the rationale of our cultural history.

Evolutionary educational psychology aims to provide researchers an explanation for the frequent failures of modern education, and some have begun to develop theses for future educational policies. It is clear that students from each end of the educational spectrum outlined by evolutionary psychologists have found success: the drilled-and-practiced students of Direct Instruction in countries such as China and Japan, and the non-directed

independent learners of Sudbury Valley school's eternal recess. Conceivably no amount of studies could conclude the superiority of either instructional method. Therefore instead of falling into a dichotomized trap, future research should begin to examine how each method can be best co-opted to match any subject area content and cultural context. Perhaps students may learn best if they could vote for the teacher and content in a Direct Instructional lesson. Moreover, modern technology such as social media has lowered the barrier between cultures, and more studies should be conducted to study the potential impact of inter-culture and age-mixed cooperative learning.

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