Evolutionary Psychology and Intelligence Research

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This article seeks to unify two subfields of psychology that have hitherto stood separately: evolutionary psychology and intelligence research/differential psychology. I suggest that general intelligence may simultaneously be an evolved adaptation and an individual-difference variable. Tooby and Cosmides's (1990a) notion of random quantitative variation on a monomorphic design allows us to incorporate heritable individual differences in evolved adaptations. The Savanna–IQ Interaction Hypothesis, which is one consequence of the integration of evolutionary psychology and intelligence research, can potentially explain why less intelligent individuals enjoy TV more, why liberals are more intelligent than conservatives, and why night owls are more intelligent than morning larks, among many other findings. The general approach proposed here will allow us to integrate evolutionary psychology with any other aspect of differential psychology.

Keywords: evolutionary psychology, intelligence research, differential psychology, Savanna Principle, Savanna–IQ Interaction Hypothesis

Evolutionary psychology and intelligence research have largely stood separately despite the fact that both of these subfields of psychology take biological and genetic influences on human behavior and cognition seriously. In some sense, this is understandable. Evolutionary psychology focuses on universal human nature, which is shared by all humans, or on sex-specific male human nature and female human nature, which are shared by all men and all women, respectively. In contrast, intelligence research (psychometrics) is part of differential psychology, which focuses on what makes individuals different from each other. Psychometrics is concerned with accurate measurement of intelligence precisely because individuals vary in their level of intelligence largely (though not entirely) because of their different genetic makeup.

Yet, as Tooby and Cosmides (1990a) articulated, the concept of universal human nature is not inimical to or incompatible with individual differences (in intelligence or other traits). Although individual differences have yet to be fully integrated into evolutionary psychology (Buss, 1995; Nettle, 2006), some evolutionary psychologists have incorporated heritable or reactively heritable (Tooby & Cosmides, 1990a) individual differences in personality (Buss, 1991; MacDonald, 1995; Nettle, 2005), sociosexuality (Gangestad & Simpson, 1990, 2000), and attachment and reproductive strategies (Belsky, Steinberg, & Draper, 1991; Buss & Greiling, 1999). Scarr (1995), and J. M. Bailey (1998) called for the incorporation of behavior genetics into evolutionary psychology in order to emphasize heritable individual and group differences and provide a fuller explanation of human behavior.

In this article, I follow the lead of earlier evolutionary psychologists who have attempted to incorporate individual differences. I seek to integrate evolutionary psychology, on the one hand, and intelligence research in particular and differential psychology in general, on the other. I aim to incorporate individual differences in general intelligence and other traits into universal human nature. I suggest how and when evolutionary constraints on the human brain, universally shared by all humans, may interact with general intelligence, such that more intelligent individuals have fewer such constraints than less intelligent individuals. I suggest that general intelligence is both a domain-specific evolved psychological mechanism *and* an individual-difference variable. I derive a novel hypothesis, called the Savanna–IQ Interaction Hypothesis, from the intersection of evolutionary psychology and intelligence research and discuss its implications. Among other things, this hypothesis suggests one possible explanation for why general intelligence is correlated with the Big Five personality factor Openness to Experience; at the same time, it calls for a refinement of the concept of novelty. I conclude with several illustrations of how and when more intelligent individuals are more likely than less intelligent individuals to acquire and espouse evolutionarily novel values.

The Savanna Principle

Adaptations, physical or psychological, are designed for and adapted to the conditions of the environment of evolutionary adaptedness, not necessarily to the current environment (Tooby & Cosmides, 1990b). This is easiest to see in the case of physical adaptations, such as the vision and color recognition system.

What color is a banana? A banana is yellow in the sunlight and in the moonlight. It is yellow on a sunny day,

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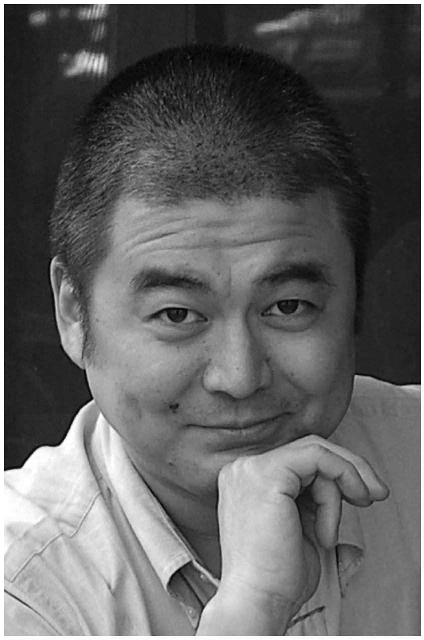

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on a cloudy day, and on a rainy day. It is yellow at dawn and at dusk. The color of a banana appears constant to the human eye under all these conditions despite the fact that the actual wavelengths of the light reflected by the surface of the banana under these varied conditions are different. Objectively, bananas are not the same color all the time. However, the human eye and color recognition system can compensate for these varied conditions because they all occurred during the course of the evolution of the human vision system, and humans can perceive the objectively varied colors as constantly yellow (Cosmides & Tooby, 1999, pp. 17–19; Shepard, 1994).

So a banana looks yellow under all conditions *except in a parking lot at night.* Under the sodium vapor lights commonly used to illuminate parking lots, a banana does not appear natural yellow. This is because the sodium vapor lights did not exist in the ancestral environment, during the course of the evolution of the human vision system, and the visual cortex is therefore incapable of compensating for them.

The same principle holds for psychological adaptations. Pioneers of evolutionary psychology (Crawford, 1993; Symons, 1990; Tooby & Cosmides, 1990b) all recognized that the evolved psychological mechanisms are designed for and adapted to the conditions of the environment of evolutionary adaptedness, not necessarily to the conditions of the current environment. I systematized these observations into what I called the *Savanna Principle* (Kanazawa, 2004a): The human brain has difficulty comprehending and dealing with entities and situations that did not exist in the ancestral environment. Burnham and Johnson (2005, pp. 130–131) referred to the same observation as the *evolutionary legacy hypothesis,* whereas Hagen and Hammerstein (2006, pp. 341–343) called it the *mismatch hypothesis.*

The Savanna Principle can explain why some otherwise elegant scientific theories of human behavior, such as the subjective expected utility maximization theory or game theory in microeconomics, often fail empirically, because they posit entities and situations that did not exist in the ancestral environment. For example, nearly half the players of one-shot Prisoner's Dilemma games make the theoretically irrational choice to cooperate with their partner (Sally, 1995). The Savanna Principle suggests that this may possibly be because the human brain has difficulty comprehending completely anonymous social exchange and absolutely no possibility of knowing future interactions (which together make the game truly one-shot; Kanazawa, 2004a, pp. 44–45). Neither of these situations existed in the ancestral environment; however, they are crucial for the game-theoretic prediction of universal defection.

Fehr and Henrich (2003) suggested that one-shot encounters and exchanges might have been common in the ancestral environment. In their response to Fehr and Henrich, Hagen and Hammerstein (2006) pointed out that even if one-shot encounters were common in the ancestral environment, anonymous encounters could not have been common, and the game-theoretic prediction of defection in one-shot games requires both noniteration and anonymity. A lack of anonymity can lead to reputational concerns even in nonrepeated exchanges.

As another illustration of the Savanna Principle, individuals who watch certain types of TV shows are more satisfied with their friendships, just as they would be if they had more friends or socialized with them more frequently (Derrick, Gabriel, & Hugenberg, 2009; Kanazawa, 2002). This may possibly be because realistic images of other humans, such as found in television, movies, videos, and photographs, did not exist in the ancestral environment, where all realistic images of other humans *were* other humans. As a result, the human brain may have implicit difficulty distinguishing "TV friends" (the characters repeatedly seen on TV shows) and real friends.

Most evolutionary psychologists and biologists concur that humans have not undergone significant evolutionary changes in the last 10,000 years, since the end of the Pleistocene Epoch, because the environment during this period has not provided a stable background against which natural and sexual selection can operate over many generations (A. S. Miller & Kanazawa, 2007, pp. 25–28). This is the assumption behind the Savanna Principle. More recently, however, some scientists have voiced opinions that human evolution has continued and even accelerated during the Holocene Epoch (Cochran & Harpending, 2009; Evans et al., 2005). Although these studies conclusively demonstrate that new alleles have indeed emerged in the human genome since the end of the Pleistocene Epoch, the implication and importance of such new alleles for evolutionary psychology are not immediately obvious. In particular, with the sole exception of lactose tolerance, it is not clear whether these new alleles have led to the emergence of new evolved psychological mechanisms in the last 10,000 years.

The Evolution of General Intelligence

General intelligence refers to the ability to reason deductively or inductively, think abstractly, use analogies, synthesize information, and apply it to new domains (Gottfredson, 1997; Neisser et al., 1996). The *g* factor, which is often used synonymously with general intelligence, is a latent variable that emerges in a factor analysis of various cognitive (IQ) tests. They are not exactly the same thing. *g* is an *indicator* or *measure* of general intelligence; it is not general intelligence itself. As a measure of reasoning ability, general intelligence is what Cattell (1971) called "fluid intelligence" (*Gf*), not what he called "crystallized intelligence" (*Gc*), which, while influenced by general intelligence, is a measure of acquired knowledge.

The concept of general intelligence poses a problem for evolutionary psychology (Chiappe & MacDonald, 2005; Cosmides & Tooby, 2002; G. F. Miller, 2000a). Evolutionary psychologists contend that the human brain consists of domain-specific evolved psychological mechanisms, which evolved to solve specific adaptive problems (problems of survival and reproduction) in specific domains. If the contents of the human brain are domain specific, how can evolutionary psychology explain general intelligence?

In contrast to views expressed by G. F. Miller (2000b); Cosmides and Tooby (2002), and Chiappe and MacDonald (2005), I proposed that what is now known as general intelligence may have originally evolved as a domain-specific adaptation to deal with evolutionarily novel, nonrecurrent problems (Kanazawa, 2004b). The human brain consists of a large number of domain-specific evolved psychological mechanisms to solve recurrent adaptive problems. In this sense, our ancestors did not really have to *think* in order to solve such recurrent problems. Evolution has already done all the thinking, so to speak, and equipped the human brain with the appropriate psychological mechanisms, which engender preferences, desires, cognitions, and emotions and motivate adaptive behavior in the context of the ancestral environment.

Even in the extreme continuity and constancy of the ancestral environment, however, there were likely occasional problems that were evolutionarily novel and nonrecurrent, problems that required our ancestors to think and reason in order to solve. Such problems may have included, for example, the following:

1. Lightning has struck a tree near the camp and set it on fire. The fire is now spreading to the dry underbrush. What should I do? How can I stop the spread of the fire? How can I and my family escape it? (Since lightning never strikes the same place twice, this is guaranteed to be a nonrecurrent problem.)
2. We are in the middle of the severest drought in a hundred years. Nuts and berries at our normal places of gathering, which are usually plentiful, are not growing at all, and animals are scarce as well. We are running out of food because none of our normal sources of food are working. What else can we eat? What else is safe to eat? How else can we procure food?
3. A flash flood has caused the river to swell to several times its normal width, and I am trapped on one side of it while my entire band is on the other side. It is imperative that I rejoin them soon. How can I cross the rapid river? Should I walk across it? Or should I construct some sort of buoyant vehicle to use to get across it? If so, what kind of material should I use? Wood? Stones?

To the extent that these evolutionarily novel, nonrecurrent problems happened frequently enough in the ancestral environment (a different problem each time) and had serious enough consequences for survival and reproduction, then any genetic mutation that allowed its carriers to think and reason would have been selected for, and what we now call "general intelligence" could have evolved as a domain-specific adaptation for the domain of evolutionarily novel, nonrecurrent problems, which did not exist in the ancestral environment and for which there are therefore no dedicated modules.

From this perspective, general intelligence may have become universally important in modern life (Gottfredson, 1997; Herrnstein & Murray, 1994; Jensen, 1998) only because our current environment is almost entirely evolutionarily novel. The new theory suggests, and empirical data confirm, that more intelligent individuals are better than less intelligent individuals at solving problems only if they are evolutionarily novel. More intelligent individuals are not better than less intelligent individuals at solving evolutionarily familiar problems, such as those in the domains of mating, parenting, interpersonal relationships, and wayfinding (Kanazawa, 2004b, 2007), unless the solution involves evolutionarily novel entities. For example, more intelligent individuals are no better than less intelligent individuals in finding and keeping mates, but they may be better at using computer dating services. Three recent studies, employing widely varied methods, have all shown that the average intelligence of a population appears to be a strong function of the evolutionary novelty of its environment (Ash & Gallup, 2007; D. H. Bailey & Geary, 2009; Kanazawa, 2008).

My theory (Kanazawa, 2004b) builds on and shares common themes with earlier evolutionary theories of intelligence, which posit climatic, ecological, and social novelties as the main forces behind the evolution of intelligence. Jerisen (1973) employed the concept of the encephalization quotient (EQ) to explain the evolution of intelligence of species as a function of the novelty of their ecological niches. Dunbar's (1998) and Humphrey's (1976) social brain hypothesis and Byrne and Whiten's (1988) machiavellian intelligence hypothesis both explain the evolution of intelligence as a consequence of having to deal with and potentially deceive a large number of conspecifics in the group. Geary's (2005) motivation-to-control theory explains the expansion of the human brain as a result of the human need to control, first its physical environment and then the social environment of fellow humans. Gottfredson

(1997) argued that other humans provide the greatest complexities in social life, which select for greater intelligence. Social relationships, while themselves evolutionarily familiar and recurrent, may occasionally add novelty and complexity that requires general intelligence to deal with.

"Intelligences"

In recent years, psychologists have discussed various forms of intelligence or "intelligences," such as emotional intelligence (Mayer, Salovey, & Caruso, 2008; Salovey & Mayer, 1990), social intelligence (Kihlstrom & Cantor, 2000; Marlowe, 1986), mating intelligence (Geher & Miller, 2007), and Gardner's (1983) notion of multiple intelligences, which include linguistic, logical-mathematical, bodily-kinesthetic, spatial, musical, interpersonal, and intrapersonal intelligences. There is no question that these are all important intrapersonal and interpersonal skills and abilities that individuals need in their daily lives. Further, it seems reasonable to suggest that there are individual differences in such skills and abilities in the realm of interpersonal relations.

However, it is not at all clear what we gain by referring to such skills, competences, and abilities as "intelligences." The concept of intelligence in its historical origin in psychology was purely cognitive (Spearman, 1904). I personally would have preferred to keep it that way; however, the tide appears to have turned against my purist position. Whether to call these intrapersonal and interpersonal competencies "intelligences" or "skills," however, is a purely semantic matter without any necessary substantive implications. At any rate, in this article, I focus exclusively on purely cognitive general intelligence and not on other forms of intelligence, for two reasons. First, this is how most intelligence researchers and psychometricians define the concept of intelligence. Although educational, social, clinical, and industrial/organizational psychologists may refer to other "intelligences" as predictors of individual performance, intelligence researchers are nearly unanimous in their exclusive focus on cognitive general intelligence (Jensen, 1998). Second, as mentioned above, the concept of *general* intelligence presents a particular theoretical problem for evolutionary psychology's modular view of the human brain. Such a modular view can easily accommodate other "intelligences" as separate domain-specific modules, but it has more difficulty incorporating *general* intelligence with its seeming domain generality.

Other people and interactions with them (including mating) are "entities and situations" that we are certain existed during the entire period of human evolution. The theory of the evolution of general intelligence would therefore predict that general intelligence would not increase or correlate with emotional intelligence, social intelligence, or mating intelligence, each of which independently evolved to solve evolutionarily familiar problems in a given domain (Mayer, Salovey, Caruso, & Sitarenios, 2001, pp. 236–237). Several studies demonstrate that general intelligence is uncorrelated (or sometimes even negatively correlated) with measures of emotional, social, and mating intelligence (Davies, Stankov, & Roberts, 1998; Derksen, Kramer, & Katzko, 2002; Ford & Tisak, 1983; Fox & Spector, 2000; Kanazawa, 2007; Marlowe & Bedell, 1982).

There is some contrary evidence, however. Mayer, Roberts, and Barsade (2009) explicitly defined emotional intelligence as an application of general intelligence to the domain of emotions, and Roberts, Zeidner, and Matthews's (2001) study shows that measures of emotional intelligence are significantly and moderately *positively* correlated with general intelligence (as measured by the Air Force Qualifying Test). The question of whether emotional, social, and mating intelligences are "really" intelligences and how cognitive they are is difficult to answer definitively because, as Mayer et al. (2008) noted, there is a very wide spectrum of approaches to these other "intelligences." Some of them take cognitive intelligence seriously, others do not.

Is Evolutionary Novelty a Domain?

The theory of the evolution of general intelligence as a domain-specific adaptation is subject to two contradictory criticisms. The first criticism is that the domain of evolutionary novelty, which encompasses all entities and situations that did not exist in the ancestral environment, is too large and undefined, and thus a set of potentially indefinite evolutionarily novel problems presents the same "frame problem" that inspired Tooby and Cosmides (1992) to advocate the domain-specific view of the human mind. The second criticism is that evolutionarily novel problems in the ancestral environment and throughout human evolutionary history have by definition been few and far between, and thus they could not have exerted sufficient selection pressure to lead to the evolution of general intelligence as a domain-specific adaptation.[1]

Is the Domain of Evolutionary Novelty Too Large?

Evolutionarily novel problems have two characteristics in common: They are unanticipated by evolution (and thus there are no dedicated modules to solve them), and they are solvable by logical reasoning. Technically, all adaptive problems, evolutionarily novel or otherwise, are in principle logically solvable. Given sufficient time and data, for example, men, collectively and over time, can eventually figure out that women with symmetrical facial features are genetically healthier and that those with low waist-to-hip ratios are more fecund, so they should find them more desirable as mates. However, for such evolutionarily familiar and recurrent problems like mate selection, evolution short-circuits the long process of trial and error and simply equips men with the module that inclines them to find women with symmetrical features and low waist-to-hip ratios sexually attractive without really knowing why. For other, evolutionarily novel, nonrecurrent problems, however, evolution has not had time or opportunity to equip humans with such dedicated modules, and they therefore

[1] I thank Jeremy Freese and Todd K. Shackelford, respectively, for articulating these views to me.

have to "figure out" the problems anew and on their own by logic and reason.

What defines the domain of evolutionarily novel problems, along with their being novel and unanticipated by evolution, is their logical solvability, and it is therefore no larger nor any less defined than other domains, such as cheater detection, language acquisition, and face recognition. After all, potential cheaters may be any kind of exchange partner, and potential deception may occur in any situation. But cheaters all have one thing in common: violation of social contract. Similarly, potential first language to be acquired by a newborn baby may come in any form; there are a nearly infinite number of natural human languages. Yet they all have key features in common, what Chomsky (1957) calls the deep structure of grammar. Hence a developmentally normal human baby, equipped with the language acquisition device, can acquire any human language as its native language, however diverse and varied on the surface such languages may be. Similarly, all evolutionarily novel problems, infinite though they may be in potential number, have certain features in common that define them, chief among which is their logical solvability.

It is not that evolution can anticipate a whole host of evolutionarily novel problems in the future (any more than it could have anticipated the emergence of new human languages such as English or German). It is just that people who have been able to solve (rare and nonrecurrent) evolutionarily novel problems in the past genetically pass on the same ability to their descendants, who can then use it to solve other evolutionarily novel problems in the future, because all evolutionarily novel problems share the common characteristic of logical solvability.

All evolved psychological mechanisms (or modules) are content rich (Tooby & Cosmides, 1992). The contents of general intelligence as a domain-specific adaptation are a set of tools that allow its possessors to arrive at logical conclusions. Such a set of logical tools may include the principle of transitivity (If A then B, and if B then C, then it follows that if A then C); what is now known as Mills's methods of induction (such as the method of difference and the method of concomitant variation); syllogism and deductive reasoning (although deduction begins with a universally true major premise, which is unlikely to have been available to our ancestors); analogy; abstraction, and so forth. In general, intelligent people are those who can use these logical tools and reason correctly and efficiently.

Is the Domain of Evolutionary Novelty Too Small?

A second criticism of the theory avers that evolutionarily novel, nonrecurrent problems could not have arisen frequently enough in the ancestral environment to exert sufficient selection pressure to lead to the evolution of general intelligence or any other adaptation. Selection pressure, however, is a multiplicative function of the frequency of the problem and the magnitude of the selective force. Even a very weak selective force could lead to an evolved adaptation if the adaptive problem in question happens frequently enough over the course of human evolution to accumulate its small effects. Conversely, even a very infrequent adaptive problem can exert sufficient selection pressure if the magnitude of the selective force (the negative consequences of failing to solve the adaptive problem) is sufficiently great.

To take an extreme example for illustrative purposes, suppose a widespread drought or massive flash flood (of a kind used in the examples of evolutionarily novel problems above) on average happens once a century (roughly five generations), but, every time it happens, it kills everyone below the median in logical thinking and reasoning ability. So the adaptive problem happens very infrequently, but the selective force is very strong. In this scenario, in only one millennium (a blink of an eye on the evolutionary time scale), the average intelligence of the population becomes greater than the top 0.1% of the original population. This is equivalent to the current population of the United States, with the mean IQ of 100, changing to a new population 10 centuries later with a mean IQ of 146. From our current perspective, the average person then will be a genius. Even if the selective force was much weaker (one tenth of the original scenario above) and the adaptive problem only wiped out the bottom 5% in logical reasoning (allowing the top 95% of the population to survive each drought or flood every century), it would still take only 13,500 years to achieve a comparable effect on the average intelligence of the population and shift it upward by more than three standard deviations.

It would therefore appear that even an infrequent adaptive problem can produce sufficient selection pressure if the selective force is sufficiently strong. It would not be unreasonable to speculate that *some* (different) novel and nonrecurrent problem happened once a century during the evolutionary past that required our ancestors to think and reason to solve and that killed off the bottom 5% of the population in such an ability. General intelligence as a domain-specific adaptation would then have evolved relatively rapidly, in less than 15,000 years.

Is General Intelligence a Domain-Specific Adaptation or an Individual-Difference Variable?

Some critics (Borsboom & Dolan, 2006) contend that general intelligence could not be an adaptation because it is an individual-difference variable. Adaptations are universal and constant features of a species shared by all its members; in contrast, there are obviously heritable individual differences in general intelligence, whereby some individuals are more intelligent than others. These critics argue that adaptations and heritable individual differences are mutually exclusive.

These criticisms betray profound misunderstanding of the nature of adaptations. A trait could simultaneously be an evolved adaptation and an individual-difference variable. In fact, *most adaptations exhibit individual differences*. Full-time bipedalism is a uniquely human adaptation, yet some individuals walk and run faster than others. The eye is a complex adaptation, yet some individuals have better vision than others. Language is an adaptation, yet some individuals learn to speak their native language at earlier ages and have greater linguistic facility than others.

Individual differences in general intelligence and other adaptations are what Tooby and Cosmides (1990a) called random quantitative variation on a monomorphic design. "Because the elaborate functional design of individuals [e.g., general intelligence as a domain-specific adaptation] is largely monomorphic [shared by all members of a species], our adaptations do not vary in their architecture from individual to individual (*except quantitatively* [emphasis added])" (Tooby & Cosmides, 1990a, p. 37).

Intraspecific (interindividual) differences in such traits pale in comparison to interspecific differences. Carl Lewis and I run at a virtually identical speed compared with cheetahs or sloths. Similarly, Einstein and I have virtually identical intelligence compared with cheetahs or sloths. It is therefore possible for a trait to be both universal and species-typical (exhibiting virtually no variation in the architecture in a cross-species comparison) *and* to manifest vast individual differences in quantitative performance among members of a single species. General intelligence may be one such trait.

Tooby and Cosmides (1990a, pp. 38–39) made this exact point, using "a complex psychological mechanism regulating aggression" (p. 38) as their example. They contended that this mechanism is an adaptation, even though there are heritable individual differences in the mechanism's threshold of activation (i.e., whether one has a "short fuse" or not). Tooby and Cosmides suggested that a complex psychological mechanism regulating aggression "is (by hypothesis) universal and therefore has zero heritability" (p. 38) even though "the *variations* in the exact level at which the threshold of activation is set are probably not adaptations" (p. 39).

The ability to run bipedally, faster than a sloth but slower than a cheetah, is a trait that is universally shared by all normally developing humans; it is a species-typical adaptation with zero heritability. But the exact speed at which a human can run is a heritable individual-difference variable and is therefore not an adaptation. Similarly, I propose that general intelligence is an adaptation and has zero heritability (in the sense that all humans have the ability to think and reason), even though the exact level of an individual's general intelligence ("IQ") is not an adaptation and is a highly heritable individual-difference variable. And Tooby and Cosmides (1990a, p. 57) contended that "nonadaptive, random fluctuations in the monomorphic design of a mental organ can give rise to heritable individual differences *in nearly every manifest feature of human psychology* [emphasis added]." One would therefore expect some individual differences in general intelligence as a domain-specific adaptation.

Explicitly recognizing that general intelligence can simultaneously be a domain-specific, species-typical adaptation *and* an individual-difference variable allows us to integrate evolutionary psychology—the study of species-typical evolved psychological mechanisms—and intelligence research—the study and measurement of heritable individual differences in general intelligence. Further, Tooby and Cosmides's (1990a) notion of the random quantitative (but heritable) variations on a monomorphic design would allow us to study individual differences in other evolved psychological mechanisms.

For example, the cheater detection module was among the first evolved psychological mechanisms to be discovered (Cosmides, 1989). It is clearly an adaptation, in that all human beings have the evolutionarily given and innate ability to detect when they might be cheated out of a fair exchange in a social contract. But are there individual differences in how well individuals can detect cheaters? Are some individuals inherently better at it than others? If so, are such individual differences heritable? Are some individuals genetically predisposed to fall victim to cons and scams?

Theory of mind is another evolved psychological mechanism; adult humans have the ability to infer the mental states of others. However, we already know that some individuals with pathological conditions (autism, Asperger's syndrome) have a weakened or absent capacity for theory of mind (Baron-Cohen, 1995). Can developmentally typical individuals also vary in their theory of mind? Dunbar (2005) suggested that there are individual differences in higher order theory of mind ("I think that you think that Sally thinks that Anne thinks that . . .") and that good writers like Shakespeare are rare because great dramas like *Othello* require writers to possess a sixth-order theory of mind. If individuals can vary in their capacity for higher order theory of mind, it seems reasonable to suggest that they might also vary in their capacity for first-order theory of mind, with some being better than others at accurately inferring the mental states of another person. If so, can such individual differences in the evolved psychological mechanism of theory of mind be heritable, since we already know that autism and Asperger's syndrome may be heritable (A. Bailey et al., 1995; Folstein & Rutter, 1988)?

Incorporating individual differences, not only in general intelligence but in other evolved psychological mechanisms, will allow us to pursue these and other questions at the new frontier where evolutionary psychology meets differential psychology.

How General Intelligence Modifies the Evolutionary Limitations of the Human Brain

The logical conjunction of the Savanna Principle and the theory of the evolution of general intelligence suggests a qualification of the Savanna Principle. If general intelligence evolved to deal with evolutionarily novel problems, then the human brain's difficulty in comprehending and dealing with entities and situations that did not exist in the ancestral environment (proposed in the Savanna Principle) should interact with general intelligence such that the Savanna Principle will hold stronger among less intelligent individuals than among more intelligent individuals. More intelligent individuals should be better able than less intelligent individuals to comprehend and deal with evolutionarily novel (but *not* evolutionarily familiar) entities and situations.

Thus, the Savanna–IQ Interaction Hypothesis (Kanazawa, 2010) suggests that less intelligent individuals have greater difficulty than more intelligent individuals with comprehending and dealing with evolutionarily novel entities and situations that did not exist in the ancestral environment; in contrast, general intelligence does not affect individuals' ability to comprehend and deal with evolutionarily familiar entities and situations that existed in the ancestral environment.

Evolutionarily novel entities that more intelligent individuals are better able to comprehend and deal with may include ideas and lifestyles, which form the basis of their values and preferences; it would be difficult for individuals to prefer or value something that they cannot truly comprehend. Hence, applied to the domain of preferences and values, the Savanna–IQ Interaction Hypothesis suggests that more intelligent individuals are more likely than less intelligent individuals to acquire and espouse evolutionarily novel preferences and values that did not exist in the ancestral environment but that general intelligence has no effect on the acquisition and espousal of evolutionarily familiar preferences and values that existed in the ancestral environment (Kanazawa, 2010).

General Intelligence and Openness to Experience

Research in personality psychology has shown that one of the five-factor personality model factors—Openness to Experience—is significantly positively (albeit moderately) correlated with intelligence (Ackerman & Heggestad, 1997). The similarity and overlap between intelligence and openness are apparent from the fact that some researchers call this personality factor "intellect" rather than "openness" (Goldberg, 1992; McRae, 1994). Although it is widely accepted by personality psychologists that intelligence and openness covary across individuals, it is not known why (Chamorro-Premuzic & Furnham, 2006). The Savanna–IQ Interaction Hypothesis can potentially provide one explanation for why more intelligent individuals are more open to new experiences and are therefore more prone to seek novelty. It is instructive to note from this perspective that only the actions, ideas, and values facets of openness to experience are significantly correlated with general intelligence, not the fantasy, esthetics, and feelings facets (Gilles, Stough, & Loukomitis, 2004; Holland, Dollinger, Holland, & MacDonald, 1995).

At the same time, the Savanna–IQ Interaction Hypothesis suggests a possible need to refine the concept of novelty and to distinguish between *evolutionary novelty* (entities and situations that did not exist in the ancestral environment) and *experiential novelty* (entities and situations that individuals have not personally experienced in their own lifetimes). Although the five-factor personality model does not specify the type of novelty that open individuals are more likely to seek, the Savanna–IQ Interaction Hypothesis suggests that more intelligent individuals are more likely to seek only evolutionary novelty, not necessarily experiential novelty.

For example, all those who are alive in the United States today have lived their entire lives in a strictly monogamous society, and despite recent news events, very few contemporary Americans have any personal experiences with polygyny. Therefore monogamy is experientially familiar for most Americans, whereas polygyny is experientially novel. The five-factor model may therefore predict that more intelligent individuals are more likely to be open to polygyny as an experientially novel idea or action.

In contrast, humans have been mildly polygynous throughout their evolutionary history (Alexander, Hoogland, Howard, Noonan, & Sherman, 1979; Leutenegger & Kelly, 1977), and socially imposed monogamy is a relatively recent historical phenomenon (Kanazawa & Still, 1999). Therefore polygyny is evolutionarily familiar, whereas monogamy is evolutionarily novel. The Savanna–IQ Interaction Hypothesis would therefore predict that more intelligent individuals are more likely to be open to monogamy and less open to polygyny. In fact, the evidence suggests that more intelligent men are more likely to value monogamy and sexual exclusivity than are less intelligent men (Kanazawa, 2010).

As another example, for most contemporary Americans, traditional names derived from the Bible, such as John and Mary, are experientially more familiar than untraditional names such as OrangeJello and LemonJello (Levitt & Dubner, 2005). So the five-factor model may predict that more intelligent individuals are more likely to give their children untraditional names such as OrangeJello and LemonJello than are less intelligent individuals. From the perspective of the Savanna–IQ Interaction Hypothesis, however, both John and OrangeJello are equally evolutionarily novel (because the Bible itself and all the traditional names derived from it are evolutionarily novel), so it would not predict that more intelligent individuals are more likely to give their children untraditional names. In fact, there is no evidence at all that more intelligent individuals are more likely to prefer untraditional names for their children (Fryer & Levitt, 2004; Lieberson & Bell, 1992).

The Savanna–IQ Interaction Hypothesis underscores the need to distinguish between evolutionary novelty and experiential novelty. It can potentially explain why more intelligent individuals are more likely to seek evolutionary novelty but not necessarily experiential novelty. It further suggests that the established correlation between openness and intelligence may be limited to the domain of evolutionary novelty, not necessarily experiential novelty, but the current measures of openness do not adequately address this proposal.

Empirical Illustrations

The Savanna–IQ Interaction Hypothesis, derived from the intersection of evolutionary psychology and intelligence research, suggests one potential way to account for some known individual differences. I discuss just a few of them here for illustrative purposes.

TV Friends

Consistent with the Savanna Principle, I (Kanazawa, 2002) and Derrick et al. (2009) showed that individuals who watch certain types of TV shows are more satisfied with their friendships, which suggests that they may possibly have implicit difficulty distinguishing evolutionarily novel realistic images of actors they repeatedly see on TV and their real friends. My reanalysis of the same data from the General Social Surveys shows, however, that this seeming difficulty in distinguishing between "TV friends" and real friends appears to be limited to men and women with below-median intelligence (Kanazawa, 2006). Those who are above the median in intelligence do not report greater satisfaction with friendships as a function of watching more TV; only those below the median in intelligence do. This finding seems to suggest that the evolutionary constraints on the brain suggested by the Savanna Principle, whereby individuals have implicit difficulty recognizing realistic electronic images on TV for what they are, appear to be weaker or altogether absent among more intelligent individuals.

Political Attitudes

It is difficult to define a whole school of political ideology precisely, but one may reasonably define *liberalism* (as opposed to *conservatism*) in the contemporary United States as the genuine concern for the welfare of genetically unrelated others and the willingness to contribute larger proportions of private resources for the welfare of such others. In the modern political and economic context, this willingness usually translates into paying higher proportions of individual incomes in taxes toward the government and its social welfare programs.

Defined as such, liberalism is evolutionarily novel. Humans (like other species) are evolutionarily designed to be altruistic toward their genetic kin (Hamilton, 1964a, 1964b), their repeated exchange partners (Trivers, 1971), and members of their deme (a group of intermarrying individuals) or ethnic group (Whitmeyer, 1997). They are not designed to be altruistic toward an indefinite number of complete strangers whom they are not likely ever to meet or exchange with. This is largely because our ancestors lived in small bands of 50–150 genetically related individuals, and large cities and nations with thousands and millions of people are themselves evolutionarily novel.

An examination of the 10-volume compendium *The Encyclopedia of World Cultures* (Levinson, 1991–1995), which describes *all* human cultures known to anthropology (more than 1,500) in great detail, as well as extensive primary ethnographies of traditional societies (Chagnon, 1992; Cronk, 2004; Hill & Hurtado, 1996; Lee, 1979; Whitten, 1976), reveals that liberalism as defined above is absent in these traditional cultures. Although sharing of resources, especially food, is quite common and often normatively prescribed among hunter-gatherer tribes, and although trade with neighboring tribes often takes place (Ridley, 1996), there is no evidence that people in contemporary hunter-gatherer bands *freely* share resources with *members of other tribes.* Because all members of a hunter-gatherer tribe are genetic kin or at the very least repeated exchange partners (friends and allies for life), sharing of resources among them does not qualify as an expression of liberalism as defined above. Given its absence in the contemporary hunter-gatherer tribes, which are often used as modern-day analogs of our ancestral life, it may be reasonable to infer that sharing of resources with total strangers that one has never met or is not ever likely to meet—liberalism—was not part of our ancestral life. Liberalism may therefore be evolutionarily novel, and the Savanna–IQ Interaction Hypothesis would predict that more intelligent individuals are more likely to espouse liberalism as a value than are less intelligent individuals.

Analyses of large representative American samples from the National Longitudinal Study of Adolescent Health (Add Health) and the General Social Surveys confirm this prediction (Kanazawa, 2010). Net of age, sex, race, education, earnings, and religion, more intelligent individuals are more liberal than their less intelligent counterparts. For example, among the Add Health respondents, those who identify themselves as "very liberal" in early adulthood have a mean childhood IQ of 106.4, whereas those who identify themselves as "very conservative" in early adulthood have a mean childhood IQ of 94.8. Even though past studies show that women are more liberal than men (Lake & Breglio, 1992; Shapiro & Mahajan, 1986; Wirls, 1986), and Blacks are more liberal than Whites (Kluegel & Smith, 1986; Sundquist, 1983), the analyses show that the effect of intelligence on liberalism is twice as large as the effect of sex or race.

Choice Within Genetic Constraints: Circadian Rhythms

Choice is not incompatible with or antithetical to genetic influence. As long as heritability (h^2) is less than 1.0, individuals can still exercise some choice within broad genetic constraints. For example, political ideology has been shown to be partially genetically influenced; some individuals are genetically predisposed to be liberal or conservative (Alford, Funk, & Hibbing, 2005; Eaves & Eysenck, 1974). Nonetheless, individuals can still choose to be liberal or conservative within broad genetic constraints, and, as discussed above, more intelligent individuals are more likely to choose to be liberal than are less intelligent individuals.

Another example of choice within genetic constraints is circadian rhythms—whether one is a morning person or a night person. Virtually all species in nature, from single-cell organisms to mammals, including humans, exhibit a daily cycle of activity called circadian rhythm (Vitaterna, Takahashi, & Turek, 2001). The circadian rhythm in mammals is regulated by two clusters of nerve cells called the suprachiasmatic nuclei (SCN) in the anterior hypothalamus (Klein, Moore, & Reppert, 1991). Geneticists have by now identified a set of genes that regulate the SCN and thus the circadian rhythm among mammals (King & Takahashi, 2000). "Humans, however, have the unique ability to cognitively override their internal biological clock and its rhythmic outputs" (Vitaterna et al., 2001, p. 90).

Although there are some individual differences in the circadian rhythm, whereby some individuals are more nocturnal than others, humans are basically a diurnal (as opposed to nocturnal) species. Humans rely very heavily on vision for navigation but, unlike genuinely nocturnal species, cannot see in the dark or under little lighting, and our ancestors did not have artificial lighting during the night until the domestication of fire. Any human in the ancestral environment up and about during the night would have been at risk of predation by nocturnal predators.

Once again, ethnographic evidence from traditional societies available in *The Encyclopedia of World Cultures* (Levinson, 1991–1995) and extensive ethnographies (Chagnon, 1992; Cronk, 2004; Hill & Hurtado, 1996; Lee, 1979; Whitten, 1976) suggest that people in traditional societies usually rise shortly before dawn and go to sleep shortly after dusk in order to take full advantage of the natural light provided by the sun. There is no indication that there are any sustained nocturnal activities, other than occasional conversations and singing, in these tribes. It is therefore reasonable to infer that our ancestors must also have limited their daily activities to daylight, and sustained nocturnal activities are largely evolutionarily novel. The Savanna–IQ Interaction Hypothesis would therefore predict that more intelligent individuals are more likely to be nocturnal than are less intelligent individuals.

Analysis of a large representative sample from Add Health confirms this prediction (Kanazawa & Perina, 2009). Net of age, sex, race, marital status, parenthood, education, earnings, religion, current status as a student, and number of hours worked in a typical week, more intelligent children grow up to be more nocturnal as adults than do less intelligent children. Compared with their less intelligent counterparts, more intelligent individuals go to bed later on weeknights (when they have to get up at a certain time the next day) and on the weekend (when they do not), and they wake up later on weekdays (but not on the weekend, for which the positive effect of childhood IQ on nocturnality is not statistically significant). For example, those with childhood IQs of less than 75 go to bed around 11:42 p.m. on weeknights in early adulthood, whereas those with childhood IQs of over 125 go to bed around 12:30 a.m..

Conclusion

This article seeks to integrate evolutionary psychology—the study of universal human nature—and intelligence research—the study and measurement of individual differences in intelligence. Tooby and Cosmides's (1990a) notion of random quantitative variation on a monomorphic design allows us to view general intelligence as both a domain-specific evolved adaptation (monomorphic design) and an individual-difference variable (random quantitative variation). Such random quantitative variation can also be highly heritable.

Although I have focused on general intelligence and psychometrics in this article, the proposed approach can integrate evolutionary psychology and any aspect of differential psychology. Aggression, theory of mind, the cheater detection mechanism, and some personality traits could all simultaneously be evolved psychological mechanisms and individual-difference variables.

The Savanna–IQ Interaction Hypothesis, which derives from the intersection of evolutionary psychology and intelligence research, suggests that more intelligent individuals are better able to comprehend and deal with evolutionarily novel entities and situations than are less intelligent individuals, but general intelligence does not affect individuals' ability to comprehend and deal with evolutionarily familiar entities and situations. The hypothesis suggests a new way to view some individual differences, such as the extent to which individuals implicitly confuse "TV friends" and real friends, political attitudes on the liberal–conservative continuum, and circadian rhythms, even when these traits are under some genetic control. As long as heritability (h^2) is less than 1.0, there is room for some individual choice.

The general approach proposed in this article will allow genuine integration of evolutionary psychology, on the one hand, and intelligence research in particular and differential psychology in general, on the other. It would simultaneously allow evolutionary psychologists to study a much wider range of psychological traits than hitherto possible and intelligence researchers and differential psychologists to make use of the theories and concepts of evolutionary psychology.

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