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PAUL ROZIN

About 17 (+/−2) Potential Principles about Links between the Innate Mind and Culture

Preadaptation, Predispositions, Preferences, Pathways, and Domains

I put forth here a series of potential principles, based on a combination of common sense and evidential support, and with a historical perspective, from the viewpoint of a psychologist who has researched in the area of brain and mind, preference and beliefs, and cultural influences. I illustrate these points or principles with examples, often chosen from the world of food, my principal area of specialization.

1 The Middle Road Is (Almost Always) Right: A Balance of Innate Predispositions and Enculturation (and Perhaps Modularity and General-Purpose Systems)

Arguments for balance either fall on deaf ears or receive the agreement that usually comes with obvious truisms—and then are ignored. Balance does not make news. Solomon Asch's (1952) truly balanced view of human nature, recognizing both the importance of the human biological heritage and the power of culture, was underappreciated. It is absurd to deny the human primate heritage, to posit that hundreds of thousands of years or more of evolution have left no mark. On the other hand, it is hard to believe that almost all of what it means to be human can be comprehended without taking into account the power of culture, and the enormous capacity of the human brain to acquire things. As Asch has said: "In short, we start with the assumption that individual men possess authentic properties distinctive of Homo sapiens and that their actions in society alter them in authentically distinctive ways" (p. 119). Comparing an unenculturated to a fully enculturated human being, Asch notes: "He would possess imagination, but not that which produces wit, comedy or tragedy. He would have a self, but not that which can stand in judgment upon itself" (p. 136). The matter becomes more interesting because innate factors have a substantial effect on the evolution of culture, and, as well, culture has had some effect on human innate capacities, as I will discuss under a later principle.

2 Finding an Adaptive Account Is Just a Beginning; Adaptive Accounts Can Be Misleading as to Mechanism and the Process of Evolution or Adoption

It is a perfectly reasonable, often productive exercise to hypothesize an adaptive value to a particular human activity or function. Indeed, one fundamental dimension of explanation within psychology is to assign adaptive values to mental and behavioral features of humans and other animals. Of course, we have to remember that humans are adapted, in most cases, to their ancestral as opposed to their current environment. In some cases, those environments may be similar, but for the important case of food, the ancestral and current developed-world environments are almost opposite to one another (see principle 13).

In any event, adaptive accounts are hypotheses, to be supported or rejected on the basis of evidence. And one type of evidence is an argument for evolvability, that is, creation of a conceivable pathway through which the adaptation was accomplished. It is often difficult to account for complex structures in terms of a set of gradual changes, each of which is more adaptive than its predecessor, but this can be, and has been, done.

I illustrate the problem of evolvability with an example from culinary history. Solomon Katz and his colleagues (Katz et al., 1974) have nicely demonstrated that the procedure for preparing tortillas, in the ancient Americas, has nutritional advantages. By boiling corn in alkali, an essential part of the procedure, three nutritionally important improvements occur. First, the alkali used (calcium hydroxide) adds calcium, a mineral in short supply in the ancient Meso-American diet. Second, the resulting alkalinity increases the availability of an essential amino acid that is otherwise bound in such a way as to not be utilizable. Third, an important vitamin, niacin, is also bound in corn in such a way as to make it unavailable, except in an alkaline medium.

Katz and colleagues (1974) also show that across the Americas, the more a society relies on corn, the more likely it is to use the tortilla technology in preparing the corn. This study is one of the best documentations of the adaptive value of a cultural practice. But there is an evolvability problem. One is unlikely to happen on the complex tortilla production technology by chance. And all of the demonstrated nutritional effects are subtle and cumulative; it is not clear how these effects could be observed. It is not like the case of bitter manioc (see Rozin, 1982); the cyanide in the manioc causes striking symptoms promptly, so the effectiveness of the leaching technique that removes it would be easily observable.

While working in a rural village in Mexico, I asked many of the residents why they boil corn in alkali as a first step in making tortillas (Rozin, 1982). The men had no idea and, in fact, didn't know how to make tortillas. The women had no ready answer, but the most common response was that the alkali processing makes it easier to roll out a tortilla, by softening the corn. I asked one of the women to try and make some tortillas for me without alkali-boiled corn. She was amused, but agreed to do so. She was right; the tortilla she made was more difficult to roll out, and had pieces of whole corn in it. Now one can imagine how people would appreciate a procedure that has such a palpable effect. But the question is: in terms of the origin of tortilla

making, what is the relation between the rather subtle nutritional adaptive values and the more palpable culinary adaptive value?

There is another interesting chapter to the tortilla story that has to do with cultural evolution. Corn was encountered by the early European explorers, like Cortez, and was brought back to Spain and ultimately the rest of Europe. In spite of the efficiency of corn as a crop, it was rarely adopted for human (as opposed to domesticated animal) consumption in Europe. Why not? Because, I think (Rozin, 1982), of the simple fact that Cortez and his fellow explorers did not have Spanish women on their early visits to the Americas. Mexican men don't know how to make tortillas, and Spanish conquistadors didn't learn how to make them. So they brought corn back to Europe (perhaps with some very stale tortillas) but not the technology to make them, and thus make the corn tastier and more nutritious. One woman among the Spaniard males could have changed European and world culinary history.

3 The Innate Mind Does More Than Affect Cognitive Processing: It Affects Norms, Cultural Institutions, Beliefs, Preferences, and Attitudes

In the last two decades, psychology has reawakened to the importance of affect, both in understanding human life in general, and more particularly in understanding cognition (Davidson et al., 2001). As we consider the innate mind, we should attend not only to computational mechanisms that function in the cognitive domain but also to affective processes, including preferences and attitudes. These may facilitate or inhibit particular types of cognitive processing. Innate preferences (as for sweet tastes) or aversions (as for bitter tastes) influence the types of interactions humans have with their environment, hence their experience, hence their mind.

4 Innate Preferences Shape Cultural Environments and Institutions

Innate predispositions affect not only the life of the individual but the culture that is shaped by the collectivity of individuals. In this way, culturally transmitted preferences and attitudes, as well as opportunities, institutions, and environments, are influenced by genetic predispositions. Humans have powerful and clearly adaptive innate preferences for sweet tastes and fatty textures (shared with rats and many other mammalian generalists; the preference for fatty textures, while widespread, has never been properly shown to be present at birth, unlike the sweet preference; Steiner, 1979). These preferences serve as useful guides to the recognition and consumption of sources of calories. They motivate human efforts to discover, collect, and cultivate plants that will provide these sensory experiences. One of the motivations for Europeans to explore the Americas was to develop environments in which to grow sugar cane. The development of sugar extraction techniques, and ultimately, in the face of caloric oversupply, artificial sweeteners, can be traced to the human predisposition to like sweet tastes (Mintz, 1985; Rozin, 1982). The elaborate processing of chocolate beans to make manifest the fatty texture inherent in the fats within the bean, and the

addition of sugar in substantial amounts to almost all human-consumed chocolate, testifies to the power of both sweet and fat predispositions. In addition, sugar is widely used (e.g., in chocolate and coffee) to mask or compensate for innately negative bitter tastes. The widespread availability of sugar, accomplished through accumulated cultural discoveries, and institutions—including food corporations—has provided readily available new opportunities for human predispositions to be regularly indulged and refined. Chocolate is a culturally evolved food that is more appealing to humans than just about anything in nature, and extremely dense, calorically. Its principal natural source is a bitter bean with unremarkable texture from Mexico, shaped to appeal exquisitely to the human palate by accumulated discoveries, principally in western Europe (Coe & Coe, 1996).

5 Culture Is Powerful Enough to Reverse Innate Preferences

One should not underestimate the power of culture. There are abundant examples in which cultures have reversed innate predispositions, whether in the sexual, social, or food domains. I will focus here on the food domain. Most cultures display a strong preference for some food that is innately unpalatable. These preferences are typically based on an acquired liking for an innately unpalatable taste. In Euro-American cultures, liking for tobacco, irritant spices like chili pepper, coffee, bitter chocolate, a wide variety of alcoholic beverages, and some vegetables are examples. I will briefly discuss the case of chili pepper, perhaps the most widely used spice in the world (Rozin, 1990a).

There is little doubt that the oral burn produced by the capsaicin in chili pepper is innately aversive; indeed, it probably evolved to deter ingestion by mammals (Rozin, 1990a). The acquired liking for chili pepper (and other innately negative oral experiences) is probably unique or almost unique to humans (Rozin & Kennel, 1983). The acquired preference is powerful enough to have motivated the spread of chili pepper from its tropical American origins to becoming a major constituent of the flavorings in most tropical and semitropical Asian and African cuisines. It is accomplished in a still poorly understood process during socialization (reviewed in Rozin, 1990a). Whatever the ultimate mechanism of acquisition of liking, culture provides coerced exposure, through the use of chili pepper in most savory foods in many cuisines. This mere exposure, by itself, may promote the reversal of an innate aversion (Zajonc, 1968). It is also possible that this exposure promotes opponent-process endorphin responses, which link a pleasant internal state to the irritating sensory experience. Second, there is probably an important effect of social influence. Humans are highly motivated to adopt the preferences of their elders; the intensely social structure of the human meal no doubt makes this particularly likely in humans, as opposed to other animals. Third, it is possible that a peculiar, uniquely human quality contributes to the preference reversal (and many other preference reversals). I have called this benign masochism (Rozin, 1990a; Rozin & Schiller, 1980), but it could also be called thrill seeking. Humans seem to enjoy the experience of negative inputs in contexts where they know these inputs are not actually threatening. Such is the case for the irritating sensations of chili pepper, the fear induced in a roller coaster, or the sadness induced by a tragic drama. In all

of these cases, and many others, the negative experience occurs in a safe environment, with minimal risk of actual harm. This seems to be an example of mind over matter, a pleasure induced by our awareness that the negative signals we are getting are not indicative of real prospects of harm. One piece of evidence for this, for chili pepper, is that the optimal level of hotness for most individuals who like chili pepper is just below the level that produces strongly unpleasant experiences (Rozin, 1990a; Rozin & Schiller, 1980). All of this may fall under a general motivation for mastery, of obvious adaptive value.

Finally, it is worth noting that one account of liking for chili, its production of elevated levels of brain endorphins, has particularly interesting biological-adaptive implications. Endorphins seem to be involved in modulating pain experiences. According to the opponent process model of learning (Siegel, 1977; Solomon, 1980), organisms learn to compensate for certain types of internal disturbances by acquiring (or innately producing) opponent processes that neutralize these disturbances. These compensations grow with exposure. One account of chili liking involves an overextension of this adaptive system. The compensatory secretion of endorphins in response to the irritation of chili pepper, as it develops with exposure, can come to dominate the initial negative response, and produce pleasure. In this scenario, the forced exposure produced by cultural forces allows an adaptive opponent process to overshoot. Normally, the aversion to the irritation would prevent repeated resamplings of a negative taste, but culture intervenes to make this happen.

6 Predispositions Affect Culture, but Culture Also Shapes the Genome

It goes without saying that the individual human is the principal initial shaping force in the development of culture. However, organized human societies, and what may be called cultures, have been a part of the human environment for tens of thousands of years. Writing, agriculture, and domestication have been a part of human life for many thousands of years. This is more than long enough to allow the human-created environment, including changes in what promotes fitness, to affect the human genome. For example, the decline in the importance of hunting for any individual or group, and related changes, have relaxed the importance for possessing high visual acuity, and the invention of eyeglasses has provided a totally adequate compensation for those with defects in acuity.

I will illustrate the effect of culture on genes with one example, milk (see Rozin & Pelchat, 1988, for an extended treatment of this issue). Milk is the first and only food for humans and other mammals for some time after birth. It is thus a complete food. Among its other properties, the substantial carbohydrate component of milk is entirely composed of a unique sugar, lactose. Lactose is found only in milk, and is composed of two linked simple sugars, glucose and galactose. The enzyme lactase, present only in the gut of young mammals, breaks lactose into its two component sugars and allows it to be digested. As milk is found only in mammal mothers, it is a food available to nonhuman mammals only in the nursing period. Appropriately, production of this enzyme declines to very low levels in virtually all nonhuman mammals at about the time of weaning. Adult nonhuman mammals cannot

efficiently digest milk: the substantial (about 40 percent of solids, depending on the species) lactose component cannot be absorbed. Furthermore, it is fermented by bacteria in the hind gut, resulting in gas, cramps, and diarrhea, and further inefficiencies in general absorption.

With domestication, milk became available as a food to humans postweaning, for the first and only time in mammalian history. But milk is an unsatisfactory food for adults, because of lactose intolerance. This problem has been handled in the evolution of humans in two opposed ways. One was to modify culture, the environment, to make milk digestible. This is through the appropriately named *culturing* techniques. If milk ferments outside the body, under somewhat controlled conditions, bacteria break down the lactose to its two digestible components, glucose and galactose. Humans have developed various ways of doing this, producing, among other things, yogurts and cheeses. These milk products are low in lactose, can be digested, and form excellent sources of nutrients.

The second route involves changes in the human genome, such that the normal deprogramming of lactose production at about weaning time is blocked. This is controlled at a single genetic locus; mutations at this locus that block lactose deprogramming would be adaptive for humans living in a milk-producing culture. We cannot at this time present a satisfactory story about how this actually happened, but we know that it did happen. People from dairying cultures, particularly of northern European origin (and a few African pastoral groups) have a high incidence of adult lactose tolerance (Rozin & Pelchat, 1988; Simoons, 1982). These, of course, are the major milk-drinking cultures of the world. Thus, for the case of milk, cultural advances made a particular genetic change adaptive, and that change occurred and predominated in certain cultures.

7 Humans, among Mammals, Have Strong Proclivities to Develop Positive Attachments to Activities and Objects: A Possible Adaptation to the Acquisition of Culture

Many have argued that humans have special evolved learning abilities that foster the acquisition of culture. One such ability is the ability to develop strong likes and allegiances, which allows for the incorporation of norms. If one likes/values a person, object, idea, or institution, allegiance to it comes naturally. Thus, a dieter who prefers cottage cheese to ice cream is going to have an easier time of it. The distinction between intrinsic and extrinsic motivation addresses this issue (e.g., Deci & Ryan, 1985; Lepper, 1983). Quite simply, intrinsic motivation is a more secure way to maintain an activity, although strong social sanctions can be quite effective in some situations, if the penalties are high and enforcement is consistent and efficient. We know relatively little about how values or likes arise, but it seems that reinforcement and punishment are not effective in producing them (Deci & Ryan, 1985; Lepper, 1983). Social influence and social perceptions seem, in general, to be very effective. Things like identification and imitation, desires to be adult and like admired figures have been implicated.

Although nonhuman animals promptly and regularly develop strong dislikes (as for toxic foods), it is relatively difficult to produce enduring likes (e.g., for foods)

in nonhuman animals. Humans, on the other hand, have powerful likings for foods, and a wide variety of other objects (e.g., stamps, sports). I have suggested (Rozin, 1982) that the flowering of positive intrinsic reactions in humans may be a consequence of the evolution of culture. Adhering to a culture means not only avoiding prescribed things but valuing positive, important things.

8 In General, in Animals and Humans, in Terms of Innate Biases and Perhaps Derived Cultural Biases, Negative Events Have More Impact on Organisms Than Positive Events

The greater power of negative events has been noted a number of times, and dealt with systematically by Peeters and his colleagues (Peeters, 1971, 1989). Recently, a wide range of evidence supporting negativity bias or negativity dominance has been marshaled (Baumeister et al., 2001; Rozin & Royzman, 2001). Negativity bias manifests itself in at least four ways (Rozin & Royzman, 2001): (1) Negative potency: negative events are subjectively more valenced than objectively equivalent opposite positive events. Loss aversion is an example of this. (2) Negativity dominance: even when one combines subjectively equated opposite valence events (a negative event whose rated negativity is the same as the rated positivity for the corresponding positive event), the net outcome is usually negative. (3) Steeper negative gradients: as one approaches (in time or space) a negative event, its negativity grows at a faster rate than the growth of positivity as a positive event is approached. (4) Greater differentiation in negative events: there is a richer vocabulary and more distinctions are made among negative than positive events. For example, in the Western taxonomy of basic emotions, there is only one positive emotion (happiness), and there are four negative emotions (anger, disgust, fear, and sadness).

Negativity dominance is particularly clear in cases of contagion. While brief contact of a positive entity by a negative one often "spoils" the positive entity, brief contact of a negative entity by a positive entity usually has little, if any, effect (Rozin et al., 1989; Rozin & Nemeroff, 1990). One touch with a cockroach spoils a favorite food, while there is nothing one can touch to a pile of cockroaches to make them acceptable as food.

There are a number of adaptive accounts of negativity bias (summarized by Rozin & Royzman, 2001). First, the ultimate negative event, death, is more final and negative than any positive event. Second, negative events are much less frequent than positive events; hence they have more information value. Third, while the general response to positive events is approach, there are diverse ways of responding to negative events, including attack (anger), withdrawal (disgust or fear), or freezing in place (fear).

9 Both Culture and the Innate Mind Often Express Themselves in Terms of Predispositions; Culture Often Operates by Promoting Default Accounts

There is abundant evidence that humans are predisposed to learn certain types of relationships that are, not accidentally, represented in virtually all human

languages. Humans are, in short, predisposed to learn at least certain aspects of language. This is a predisposition, not a fixed limitation. That is, humans can learn arbitrary linguistic relationships, but it is more difficult. Language is a good model for understanding humans in general. In both biological and cultural evolution, predisposition is a particularly common way of producing an outcome. Imprinting involves predispositions, and it works because both the predispositions for features of the target of imprinting resemble features of one's own species, and because the environment conspires to virtually guarantee the presence of that very organism in the environment of the newborn or young organism.

Within cultures, predispositions can often be described as defaults (Rozin, 2003). That is, cultures promote certain ways of feeling, certain motivations, and certain ways of construing the world. These become default modes of operation. Under most circumstances, the default arises and continues to occupy attention, or direct behavior. Other modes of thought or behavior are possible, but do not usually occur because of the greater salience of the default. Under conditions where the default is inadequate, alternatives may be tried.

Many of the cognitive differences between the left and right brain hemispheres or, respectively, the Western and Eastern hemispheres (very, very roughly, including Asia, Africa, and Latin America as east, and North America and Europe as west) can be described as defaults. The left hemisphere is capable of some gestalt processing, and the right of some analytic processing, but each has its preferred mode of operation, and unless forced by circumstance, will proceed in its analytic or holistic mode, respectively.

Similarly, the collectivist ("East") cultures seem to have a more holistic approach to the world, looking more at relationships and less at isolated individual components (Nisbett, 2003). This does not mean that Americans cannot think holistically or Japanese, Chinese, or Indians analytically, but rather that they are predisposed otherwise.

Levy and Trevarthan's (1976) work on split brains illustrates predispositions related to hemisphericity beautifully in a chimeric figure classification task, applied to split brains. I have reformulated the task, to make it conceptually clearer, into a task with normal (as opposed to chimeric) figures, using the same illustrations and logic (see fig. 3.1).

Each hemisphere of the split brain is queried as to which of the bottom row of three in figure 3.1 "goes with" each of the top entities. Note that, in this clever design, there is one choice that matches on visual form and another that matches on function. Levy and Trevarthan found that the left hemisphere reliably chose the function match and the right hemisphere the form match, such that, for example, the right hemisphere would match the birthday cake with the similarly shaped hat and the left hemisphere with the fork and knife. I have repeated this test on American college students, and find that almost all reliably pick either all three formal matches or all three functional matches. (This observation suggests a default mode of response, but it would need to be shown to be stable across time and generalized to similar tasks in order to qualify as a general difference in functional/formal default.) That is, normal individuals may have a default way of looking at things, which is either formal or functional. But these same individuals are quite

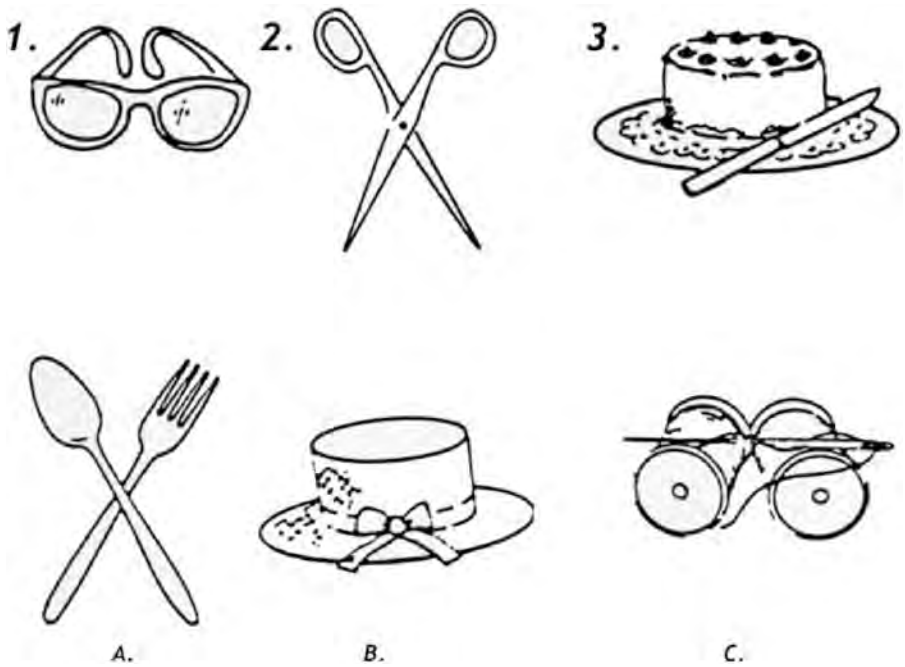

FIGURE 3.1 Figure classification task to illustrate predisposition for formal versus semantic-functional modes of processing. Participants (split-brained individuals or normal college students) are asked to indicate which item in the bottom row corresponds to "goes with" each item on the top row. Each item in the top row corresponds to one item on the bottom row on the basis of resemblance in visual form and to another on the basis of semantic-functional criteria. The presentations to participants were accomplished in three trials, in each of which only one of the top items was present. *Source*: Modified from Levy and Trevarthan (1976), fig. 1.

capable of understanding and applying the alternative strategy. This "processing predisposition" in normals no doubt relates to some sort of hemispheric dominance.

In a similar type of design, Zaidel (1990), presented split-brained individuals with a peculiar face (fig. 3.2), in which the features (eyes, nose, mouth) appear in switched positions.

It was found that when asked to point to the "nose," the left hemisphere (right hand) pointed to the literal nose, now in the eye position, whereas the right hemisphere (left hand) pointed to the normal position of the nose (now represented by an eye). With American college students, I have found (unpublished data) that some spontaneously point to the physical nose, and others to the proper location of the nose. This difference seems to illustrate a privileging of relational/gestalt or analytic strategies, and maps nicely onto Nisbett's (2003) analysis of prominent East Asian versus American modes of thought, although no data is currently available to compare such groups on this task.

FIGURE 3.2 Participants are asked to point to the "nose" on the face. The right hemisphere (left hand) of split individuals with split brains typically points to the correct position for the nose (an ear in the picture), while the left hemisphere (right hand) typically points to the literal nose, in the eye position. American undergraduates are divided on which choice they make. *Source*: Zaidel (1990).

Free associations can be used to look at predispositions, because they are, by definition, the first thing that comes to mind (Rozin et al., 2002). For example, in response to the word "chocolate," Americans are more likely to mention the word "fat" in one form or another ("fat," "fatty," "fattening") than are either Asian Indians or French.

Another technique that elicits defaults is the use of triads (illustrated in one form in fig. 3.1) or alternative associations. In the triad technique, a person is given three words, and is asked which of the two belong together (or which doesn't belong with the other two). In the alternative association technique, using the same three words, a person is asked which of two belong with one that is selected. Thus, in an illustration of social/collective versus individualistic/hedonic thinking, Menon and Shweder (1997) asked Hindu Indians and Americans which does not belong with the other two: ANGER, SHAME, HAPPINESS. In a small sample of traditional Hindu Indians and Americans, they found that the Indians reliably selected anger, and the Americans happiness. This finding was confirmed with a much larger sample

of Indian and American college students (Rozin, 2003), using the alternative association method: (what "goes with" SHAME: ANGER or HAPPINESS), although the differences were not as extreme as with the more traditional samples. Americans explain their choice by saying that ANGER and SHAME are negative, and HAPPINESS is positive. Indians explain their choice by saying that SHAME and HAPPINESS are socially constructive, while ANGER is socially destructive. All participants interviewed acknowledge the basis for the construal opposite to their own; they just don't usually think that way. Importantly, this "bias" may have powerful effects, because one usually proceeds from one's original construal to further implications.

This general position has been called frame switching within a dynamic constructivist view of culture (Hong et al., 2000). It has been possible to shift people, including biculturals, from one predominant frame (default) to another by surprisingly simple priming procedures, in which the participant is exposed to things associated with one or another culture (including flags, buildings) (Brewer & Gardner, 1996; Haberstroh et al., 2002; Hong et al., 2000). The idea that a variety of cultural systems are differentially accessible in any individual has been put forth in a variety of forms in the recent literature in cultural psychology (Hong et al., 2000; Oyserman et al., 2002). The idea of default, frame switching, or differential accessibility has been around for some time (e.g., Rozin, 1976a, in relation to the evolution of intelligence) but has come to the fore in recent work.

10 Cultural "Norms" Are Typically More Extreme than Cultural Behavior or the Enculturated Mind

One function of norms is to push people away from their predispositions (Rozin, 2003). We are appropriately impressed by cultural differences; these constitute a major motivation for world travel. Yet, when psychologists seek to measure differences between the peoples in one culture and another, the differences almost always appear as quantitative, and sometimes account for much less than half of the variance (the same may be said for most behavioral sex differences). Even on items specifically selected to highlight cultural differences, the overlap between individuals is high. Perhaps the most researched cultural difference in the literature in cultural psychology has to do with the individualism-collectivism dimension (Markus & Kitayama, 1991; Triandis, 1995). The United States has one of the most distinctly individualistic societies, and India one of the most collectivist. Collectivism can be instantiated by the statement "Solidarity is more important than individuality." Yet only 62 percent of a sample of Indian college students in a rather traditional Indian city endorse this claim, and 10 percent of American students do (Rozin, 2003). On another item directed at the same difference: "The nail that stands up gets hammered down (nonconformity is discouraged)," 59 percent of the Indian students agree, in contrast to 27 percent of the American students. Indian endorsement of these statements would no doubt be higher in older Indian adults, but we also have evidence (Rozin, 2003) that American endorsement of the same statements is also higher in older American adults than American college students. Many extensive studies of cultural differences (Hofstede, 1982; Oyserman et al.,

2002) reveal important and significant cultural differences on important dimensions, but substantial overlap as well.

If we, reasonably, assume universal human predispositions in the social domain, we then confront conflicts between these and important cultural values (e.g., either individualism or collectivism). So, for example, if we assume that humans have both collectivist and individualist dispositions, depending on, among other things, domain of activity (Fiske, 1991, 1992), the cultural values/norms often have the function of pushing humans away from their "natural" balance in these predispositions. Perhaps the reason transcultural norm differences are bigger than transcultural individual differences is that it is necessary for cultures to establish rather extreme norms, to optimally motivate departure from natural predispositions (Rozin, 2003). To move a population x units in the direction of collectivism, it may be optimal to set a standard at $2x$ units.

11 Cultural Influence May Be More Prominent in the Area of Behavior than in the Area of Mental Events

Unlike the other principles asserted in this essay, this one is based only on common sense, with no direct empirical evidence. It derives simply from the fact that it is much easier to shape (reinforce, build institutions or environments to promote) behavior, because it is observable, than mental events (Rozin, 2003). Behavior must be used as the marker for mental events, in order for a third party (individual or culture) to attempt to affect mental events. Surely this occurs abundantly, but because the control is indirect, and verification is indirect, it seems very likely that the thought-shaping process is less potent and successful. In some sense, the existence of intrinsic versus extrinsic preferences illustrates change in thought and affect versus behavior.

It would be of interest to obtain actual data on this point, although this would be difficult. In addition, it is likely that the degree of effort needed to shape mental events, as opposed to behavior, varies both by culture and domain of activity. For example, Judaism seems more oriented to shaping behavior, and less to shaping mental events, than Christianity (Cohen & Rozin, 2001).

12 Domains Are Critical in Understanding Links between the Innate Mind and Culture

The realization that adaptations are often domain specific (e.g. Rozin, 1976a; Rozin & Kalat, 1971) has extended in recent decades into the domain of cognition, particularly in the form of an emphasis on modularity (Fodor, 1983). Different activity domains (eating, sex, communication) (and different sensory systems, as well) face different problems in representation, acquisition, and action, and brains seem usually to make appropriate, specialized adaptations. For example, learning occurs with delays of hours between ingestion and its consequences in the food domain (where such intervals are a necessary aspect of the digestive process), but much less so for other domains of activity. Similarly, at least for food generalist animals like humans, distinguishing between edible and safe versus harmful potential

foods must be based on experience, whereas, in the sexual domain, mate recognition can often be prewired. Mayr (1974) refers to food as an open system and mate selection as a closed system. There are also arguments for easier evolvability of domain-localized systems. This general approach has been applied to culture (e.g., Cosmides & Tooby, 1994). It remains an open question as to when and how more general problem-solving systems arise.

The most explicit application of domain specificity in the broad realm of social behavior is Alan Fiske's (1991, 1992) four models of social structure, which map in specific ways onto particular domains of life, such that, in most cultures, for example, communal sharing is characteristic of family relations and meal contexts.

Domain specificity (modularity, adaptive specializations), while accepted to some degree in the study of cognition and language, has not penetrated very deeply into psychology. For example, introductory psychology texts, or more specialized texts in social psychology or developmental psychology, pay little, if any, attention to how humans function in different domains of life (e.g., work, eating, leisure activities and the arts, religion; Rozin, 2005).

13 There Are Major Changes between the Ancestral and Contemporary (Culturally Evolved) Environment, Particularly Striking in the Domain of Food

It is a truism that most (human) adaptations can be understood as promoting fitness in the ancestral environment in which they evolved. In the case of humans, there have been massive changes in that environment in about the last 8,000 years, due to the evolution of culture, and associated technological advances. This situation allows for mismatches in which adaptations to the ancestral environment may be maladaptive in the relatively recent contemporary environments. This situation is particularly common in the domain of food, and in particular, energy regulation.

Virtually all animal species studied show some ability to regulate energy intake, that is, to match energy intake with energy expenditure in their adult phase. This, of course, serves to maintain a presumably optimum weight. In addition, virtually all animal species studied minimize energy expenditure, such that as little energy as possible is spent in searching for and consuming food. This extensive set of findings is summarized under the term "optimal foraging." Unnecessarily increased energy expenditure in searching for food requires more time searching for food, at the cost of other activities, and yielding increased exposure to predation. Both regulation of food intake and optimal foraging are clearly adaptive in the ancestral environment.

Following upon the development of agriculture and domestication, human societies have become massively transformed, by these technologies and the technologies that they permitted or encouraged, through establishment of a stable food supply that required much less individual effort to procure (Diamond, 1997). The changes, in the food domain itself, escalated during the twentieth century, in the developed world, resulting in a food environment that is almost the opposite of the ancestral environment.

In the ancestral environment, food is relatively scarce. In the contemporary (developed-world) environment, food is abundant. The evolved food regulation system was oriented primarily to motivate ingestion in cases of shortage. Hunger plays this role. Mechanisms to prevent overconsumption are less powerful.

In the ancestral environment, with the exception of meat, there were very few foods that were calorically dense (e.g., high in fat and containing minimal noncaloric components). In the contemporary environment, technology has produced superfoods, which have very high caloric density and combinations of desirable sensory properties not encountered in the natural world. Chocolate is an example, incorporating the sweet and fatty properties so innately appealing to humans. Restraint in the face of such choices was not a part of our inherited equipment.

The variety of edibles is modest in most ancestral environments, but an enormous variety of foods is available in the contemporary environment: foods from all over the world, in any season, are now available in local supermarkets. Variety encourages increased intake, creating another force for overconsumption in the contemporary world (Rolls et al., 1986).

The linkage between energy expenditure and consumption of food, present in the ancestral environment, has been broken in the contemporary world. One can now obtain a week's supply of food on one trip to the supermarket by car, with virtually no energy expenditure.

In the ancestral environment, there were clear linkages between ingestion and its negative consequences. Toxic or infected food would promptly produce negative symptoms, and the organism could learn to avoid such foods (e.g., conditioned taste aversions). As a result of the epidemiological revolution, that is, the conquest of most acute infectious diseases, and the development of sanitation and food-borne toxin controls, the short-term risk of illness or death from food consumption has been drastically reduced. In the contemporary developed world, the health risks and benefits of foods, or food ingestion patterns, manifest over many decades, rather than hours. Humans are unable to notice and act on such contingencies. The development of epidemiology has enabled humans to document the long-term relationships between diet and health, and to communicate these widely. The risks so described are probabilistic and small, below any level that evolved biological mechanisms were designed to detect.

The result of all these changes is that an organism adapted to ensure sufficient energy supplies, with a satiation system that is opposed by easily available, highly palatable food, is confronted with a level of temptation and stimulation that easily overwhelms the innately wired satiety system. And, most critically, an organism finely tuned to spend as little energy as possible to obtain energy faces an environment in which the link between energy expenditure and energy procurement is broken; "convenience" (read as energy efficiency), highly adaptive in the ancestral environment, becomes an easy route to obesity in the early twenty-first-century developed world.

There is another general adaptation of a wide range of organisms to the ancestral environment that has been neutralized or perhaps reversed in the modern developed world. The sympathetic magical law of similarity is a strategy or heuristic that is widely operative in the animal kingdom. As described by Mauss (1902/1972)

and others (see Rozin & Nemeroff, 1990, for a review), in one of its forms, the law holds that "appearance equals reality." That is, things are what they appear to be. For example, if something *looks like* a tiger, it *is* a tiger—obviously an adaptive system. However, for modern humans, a good part of their visual contact with the world is through images. Images, of course, are not what they appear to be. A picture of a tiger is not a threat. But this primitive part of our cognition continues to exert its effect; that is, we tend to respond to images that we know are images as if they are actual exemplars of what they appear to be. For example, in the food domain, we have shown that individuals are reluctant to consume a piece of fudge shaped to look like "dog-doo" ("looks like dog-doo, is dog-doo") or to drink apple juice served in a brand new bed pan ("looks like urine, is urine"), even though the individuals in question know, from direct observation, that both choices are edible and desirable (Rozin, Millman, & Nemeroff, 1986; Rozin, Haidt, et al., 1999).

14 The Food Domain Is Virtually Unique among Biological Domains, in That It Has Been Elaborated So Much by Culture That Its Biological Roots Are Often Disguised

Leon Kass (1994), in his brilliant book *The Hungry Soul*, shows how the very biological food system has been vastly transformed by culture. Unlike the other fundamental biological systems (e.g., sex, excretion, breathing) food has become deeply entwined in the social and moral world. It is the only major biological function (other than breathing) that is typically, and crossculturally, performed in public, and in such a way (as a result of table manners) as to transform its appearance from its animal origins. As Kass points out: "Like the ballerina who 'defies' gravity, so the graceful eater 'defies' neediness and eats as if he were not compelled to do so" (p. 158). This means that in thinking about the relation between the innate mind and culture, we may come up with a more culturally freighted story for the case of food. In the service of functions other than nutrition, and under strong social stimulation, innate aversions are reversed, food assumes ritual functions that—as in the case of taboos—may interfere with optimal nutrition, and elaborate food preparation and consumption traditions develop that have no relation to the basic biological function of food.

15 The Elaboration of Food, and the Cultural Evolution of Disgust, Illustrate the Fundamental Principle of Preadaptation, in Cultural Evolution

Preadaptation is a major force in large- (and small-) scale evolutionary change. According to Ernst Mayr (1960; see also Bock, 1959), perhaps the leading evolutionary biologist of the twentieth century, most major "new" structures and abilities are not evolved gradually, *de novo*, but rather build on existing adaptations and programs. Entities evolved for one purpose (or occasionally, neutral features, hence the word *exaptation*—Gould & Vrba, 1982) come to be used for another. In a sense, preadaptation is comparable to genetic recombination, as opposed to mutation and the development of new genetic material.

The human mouth is a particularly appropriate and striking example of preadaptation. The teeth and tongue evolved for food processing, but they are later used by the language system for speech articulation. Notably, this is a preadapted food system being used for another purpose. Given the fundamental importance of food procurement and selection, it is not surprising that many primary adaptations would appear in this domain. It is possible that even the first forms of conditioning appeared first in the food domain, and later became more generalized. There is also evidence in children that reasoning about contamination and other food-related matters may be more advanced than reasoning in other domains (Siegal, 1996).

Food is, biologically, about nutrition, but in humans, it becomes embedded in many other domains. Food is a major social instrument; for example, it provides a major set of occasions for social exchange, at meals. It is used to both express intimacy (as with sharing food) and to create social distance, as in the Hindu caste system. Food also becomes an art form in cuisine, which can hardly be justified on nutritional grounds. Food is a major source of metaphors (Lakoff & Johnson, 1980), as when we say that someone is sweet, or that something is in bad taste, or that we cannot stomach an argument. A metaphor is a form of preadaptation: use of a word from one domain to express something in another domain. Finally, food becomes tied into moral systems, especially in some cultures, such as Hindu India (Appadurai, 1981).

My colleagues and I have argued that just as food and food-adapted systems transfer to other domains, so does the emotion of disgust, by a combination of preadaptation in biological and cultural evolution (Rozin et al., 1997, 2000). Briefly, we argue that the disgust system is originally, in many mammals, a system for rejecting foods based on bad taste. The facial expression and associated nausea seem oriented to rejecting food and preventing further ingestion. This "distaste" system is present in rats, and human infants. However, in human cultural evolution (and development), this "get this bad taste out of my mouth" system is utilized more and more widely, as a general instrument of socialization, until it becomes something more like "get this out of my soul." First, many potential foods, especially body products and decayed matter, come to be disgusting, on the basis not of their taste but the idea of what they are. This core disgust then expands to disgust at a whole set of reminders of our animal nature; humans seem to want to turn their backs on their animal nature, particularly the animal feature of mortality. Notably, the odor of decay or death is the quintessential odor elicitor of disgust. Yet later, other people, usually strangers, or other groups, are included in disgust, and finally, disgust becomes one of a set of moral emotions (Rozin, Lowery, et al., 1999). It becomes the emotion of negative expression when moral violations related to purity and divinity are encountered. The general elaboration of disgust into the social and moral domain is described in rich detail by William I. Miller (1997).

A critical feature of disgust is contamination: when something disgusting touches an otherwise edible or desirable entity, it renders it unacceptable. This powerful negation, originally functioning in the food domain (e.g., with contact with feces) becomes generalized, just as disgust does, to wider and wider domains,

including contact with strangers or immorality. As is often the case with preadaptation, in this situation, the original preadaptation, the negative response to bad-tasting food, ceases to function in the new system. That is, although the bad taste and disgust systems share an expressive (e.g. facial) system, some of the general features of disgust are not shared with the distaste response. Thus, distasteful foods are not contaminating, whereas virtually everything disgusting is.

Another domain where preadaptation is a basic process is pleasure itself. Whatever the circuits that produce this positive feeling, originally linked to biological necessities, the system is expanded in humans to include mastery and aesthetic appreciation (Rozin, 1999).

16 Preadaptation, While Very Important in Biological Evolution, Is Even More Important in Cultural Evolution, Because Purpose and Foresight Enhance It in Cultural Evolution

As important as preadaptation is in biological evolution, it is much more important in cultural evolution. Preadaptation in biological evolution is limited by the fact that borrowing an adaptation requires (1) that it is borrowable, that is, that some sort of (e.g., neural) contact can be made between the new and the old domain, and (2) that all stages of borrowing have adaptive value (Bock, 1959). This is often problematic biologically, but is not a problem in cultural evolution, because teleology is actually at work in cultural evolution. That is, one can imagine a new use for a system, and make it happen. One can put up with failure (which is typically terminal in biological evolution) while one perfects a system, with the end in mind. So, one can make trucks out of cars without a gradual set of stages; one can combine a calculator and a typewriter, with many false starts, to make a computer; and so on. Preadaptation is rampant in cultural evolution. The expansion of disgust illustrates this. If something is undesirable in any culture, efforts can be made to make it disgusting, through a socialization process. Disgust is a very effective way to discourage contact or interaction.

17 A Major Influence of the Innate Mind on Culture, and Culture on the Innate Mind, Is through Institutions and Alterations of the Environment: The Innate Mind to Enculturated Mind Link Is Often Mediated by Matters outside the Head

"Culture" exists in the environment (e.g., cities, streets, homes, places of worship, markets, conveniences) as well as in the minds of members of a culture. Indeed, international tourism is based largely on people's interests in observing other cultures' environments. Environments provide major constraints for behavioral options, and alter the likelihood (environmental "predispositions") for different behaviors (Rozin, 2003). By altering the perceived world, and the arena for action,

environments influence minds and mental development. In the psychology of recent decades, there has been a strong emphasis on mental events, consequent upon the cognitive revolution, and a reaction against behaviorism. This emphasis carried over into the earliest forays by psychologists into the study of culture (e.g., Markus & Kitayama, 1991). However, more recently, cultural psychologists have come to appreciate the power of the cultural environment. Kitayama (2002) has pointed to the importance of the environment created by cultures, and Kitayama and Markus (1999) promote the term "cultural affordances" to encompass situations, structures, artifacts, and customs in which the individual is interactively embedded.

The influence of the physical and physical-social environment, such as institutions, on behavior and mental events has been attended to much more in sociology than in psychology. The lack of attention in psychology may be a result, in part, of the fact that the mechanisms through which environments operate are frequently transparent. People can only take trains, go to school, and eat pineapples if these opportunities (affordances) are part of the environment. This truism seems trivial, and it is, if one's aim is to uncover nonobvious principles of mind and behavior, as opposed to understand why people think and do the things they do. The importance of writing, a deeply important feature of the environment, as affording reading and allowing for major changes in the nature of education and communication is obvious, but central to understanding modern human beings. And the type of writing system employed in a culture can influence, in a major way, the ease of learning to read, the ability to electronically code writing, and the degree of literacy. For example, modern Chinese is easier for children to conceptualize and learn at the earlier stages of reading but harder for adults to fully master (on account of the many thousands of symbols that must be learned). We have a tendency to take these environmental effects for granted, perhaps making something like the fundamental attribution error in underrating the importance of the environment as a determiner of behavior and mental events.

The great bulk of research in psychology on eating has been devoted to the internal signals (blood levels of nutrients, stomach fill, etc.) that promote or deter eating. Such influences are undoubtedly present. But I believe it is hard to deny that for most humans, the major determinants of how much is eaten at a meal are the presence of food and its palatability—both features of the environment. We recently demonstrated that amnesic individuals, who had no memory of having eaten a recent meal, would consume a second and even a third meal if presented with appropriate meals in an appropriate lunch context (Rozin et al., 1998). More generally, cultural rules about amount to be eaten and times of eating, availability, cost, and palatability seem to be the principal determinants of amount eaten in a given meal (Pliner & Rozin, 2000).

The French eat a highly palatable diet, and eat a higher percent of calories as fat in their diets than Americans. Yet the French are noticeably less overweight than Americans. In our attempt to understand why this state of affairs exists, we have concluded that a major part of the explanation has to do with differences in eating environments. French food portions are notably smaller than American food portions, in both restaurants and supermarkets (Rozin et al., 2003). People simply eat

less when they are served less, and the proper range of portion sizes becomes strongly ingrained in cultural practice.

The same type of analysis could be applied to energy expenditure, the other half of the obesity equation. Cultural affordances can promote or deter energy expenditure. In France, very high gas prices, a less car-friendly environment, and the location of basic food stores in every neighborhood promote walking over driving. In much of modern American society, the environment, from garage to mall, has been structured so that walking is almost unnecessary. And since, as I noted earlier, it is in our genes to spend as little energy as necessary to gain necessities, Americans reasonably opt for the most convenient affordances plentifully provided by their culture.

The innate mind influences the development of the structure of the cultural environment, and that environment has set up different selection pressures (e.g., for good driving as opposed to walking ability) that can and will affect the innate mind.

18 Innate Predisposition, Socialization, and Structuring of the Environment Operate to Constrain Departures from Certain Pathways, as in Canalization

In his classic work in developmental biology, *The Strategy of the Genes*, Waddington (1957) addresses the problem of how, in the face of many predictable and unpredictable perturbations, the process of normal early development continues on an almost unerringly adaptive path. He coins the term *canalization* to refer to the fact that certain adaptive pathways (including choice points) are laid out, and established by multiple constraining forces, such that it is very difficult for the developmental trajectory to depart from these pathways. He illustrates this idea with a downwardly slanted surface that represents the range of developmental possibilities, with a ball rolling down this surface as the actual course of development (fig. 3.3). Deep channels in this surface serve to keep the ball on certain pathways, and choice points occur along this pathway.

Canalization applies directly to ideas about cognitive and affective development in humans. Furthermore, with the powerful importance of culturally created environments and norms, further channels of canalization are available to steer human development. Schools are a primary example, as are traditions of child rearing, covering issues such as use of punishment and modes of toilet training and weaning. In addition, adult activities are generally channeled by cultural artifacts. A simple example is a path through a park or woods. The path provides an easy route, involving minimal effort, for traversing an area, and people (and, by the way, dogs) tend to follow these paths, though departures are easy. Cultures provide easy ways of doing things, and children and adults tend to follow these pathways. One can wash dishes by hand, but it is easier to use the dishwasher; one can walk eight blocks to the store, but it is easier to drive. These sometimes crude and sometimes subtle influences can have a massive effect on our activities, and as a result on our experiences, and ultimately on our minds.

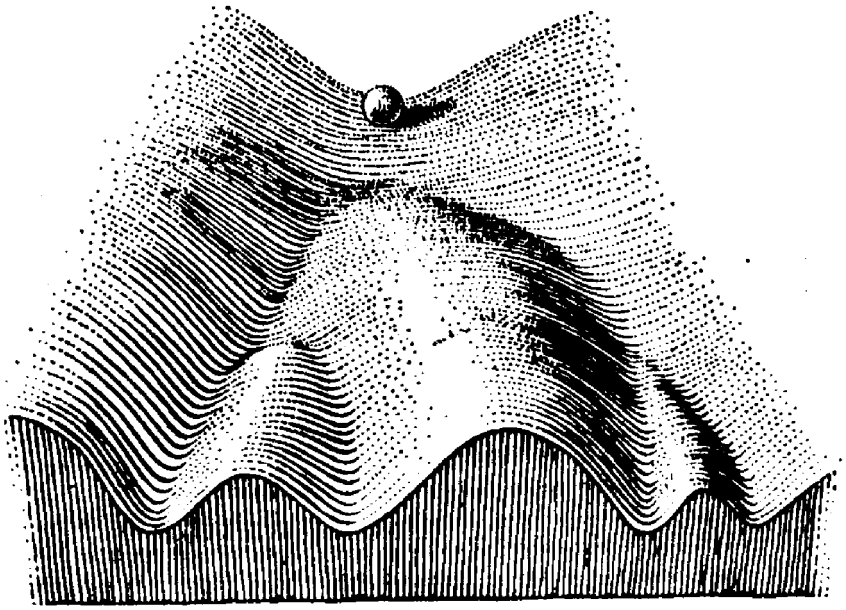

FIGURE 3.3 The development landscape, illustrating the principle of canalization. The rolling of the ball down the inclined plane represents the course of development, and the channels represent the canalized pathways. *Source*: Waddington (1957), p. 36.

19 Accessibility Represents the Same Process as Preadaptation, but Occurring during Development

In a 1976 essay, "The Evolution of Intelligence and Access to the Cognitive Unconscious" (Rozin, 1976a), I proposed that a major feature of the evolution of intelligence was gaining access to existing adaptive specializations (modules) so that their processing capabilities could be applied to new inputs and outputs. This, of course, is an application of the idea of preadaptation to the process of development. Piaget's (1955) concept of vertical decalage is precisely this; a particular ability appears in one domain first, and gradually, with development, expands to other domains. This holds for the idea of constancy, for example.

The principal example I used to develop this idea was the history of the alphabetical writing system (Gleitman & Rozin, 1977; Rozin & Gleitman, 1977). So far as we know, the alphabet was "invented" only once, somewhere in the Middle East. In most respects, it is the most efficient writing system, in that it encodes all of language (speech) into a set of 20–40 written characters. If one learns the characters and the corresponding phonemes, one can now represent and understand any speech utterance via the medium of writing. The memory load is minimal, as are the requisite writing skills. And, in the modern world, digitalization is particularly easy because of the small number of characters.

Given all of these advantages, it is surprising that the alphabet was only invented once (although it has certainly spread widely). Furthermore, although the alphabet is the easiest system to master and employ for adults, it is also the hardest for children, at the initial stages of learning. This is because the idea of the alphabet is difficult to appreciate. The alphabet is built on the principle of phonological segmentation in the speech system. The continuous stream of speech is segmented in the system (brain) into elementary units, called phonemes. Although phonemes have definite reality in the system (brain), they do not have an independent physical existence in the sound stream. The word "bag," in its motor organization and perception, has three component sounds, but these cannot be recovered from the physical representation of the sound stream, which is continuous. This is because the B, A, and G distinct articulatory commands coming from the brain are shingled when realized in the oropharynx. So while it is true that "bag" has three sounds, this is not obvious. It was this deep conscious realization that what seems continuous is actually segmented that allowed for the development of the alphabet. This involves gaining access, at some level, to the mind's (brain's) speech segmentation module.

Our work and that of others (summarized in Gleitman & Rozin, 1977; Rozin & Gleitman, 1977) supports this interpretation in three ways: (1) Understanding phonological segmentation is a major barrier to the acquisition of alphabetic systems; (2) Syllable-based writing systems, which were common in the history of writing, are much easier to acquire—the syllable is the smallest speech unit that can be separated out physically in the sound stream (*Baghdad* is composed of separable sound elements, BAGH and DAD); (3) once one understands the alphabetic principle, it seems entirely intuitive. Indeed, it is hard to convince reading teachers that the fact that "bag" has three sounds has to be taught.

Preadaptation in biological and cultural evolution, and accessibility, all refer to the same process of borrowing. The basic structure of each is laid out in table 3.1.

In all three cases, the original source may remain intact, or be replaced by the preadapted/accessed entity. My argument is that this is a deeply fundamental family of processes for the understanding of evolution, culture, and development.

TABLE 3.1 Three modes of utilizable existing programs for new purposes.

Process	Domain of Activity	Example
Preadaptation	Biological evolution	Mammalian inner ear bones
		Human mouth as a vehicle for speech
Preadaptation	Cultural evolution	Applications of computers, to word processing and other domains
		Applications of motors, wheels, writing over wide domains
Accessibility	Individual development	Acquisition of alphabetic principle
		Piagetian vertical decalages

20 Conclusion

I began this essay with 17 principles in mind, but added plus or minus 2 to provide a margin for error. In writing it, the list expanded to 19, which, fortunately, falls within the scope of the title. I hope that some of these principles prove fertile or stimulating to some readers. In general, I see these principles as emerging from a combination of findings from evolutionary biology, neuroscience, psychology, linguistics, and anthropology. Insofar as this list is useful, it also argues for the importance of the food domain as a source of innovation in biological and cultural evolution, and in development.

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