Understanding Risk-Taking Behavior: Insights from Evolutionary Psychology

KARIN MACHLUF and DAVID F. BJORKLUND

Abstract

Evolutionary developmental psychology posits that natural selection has operated across the lifespan, but especially in childhood, shaping psychological mechanisms that foster survival during the early years of life and also preparing children for life as adults. The tenets of evolutionary developmental psychology are briefly reviewed, along with a summary of life-history theory. Differential susceptibility theory and biological sensitivity to context theory are also outlined and applied to mental health. Adolescent risk-taking behavior is then examined from an evolutionary developmental perspective, assessing the independent contributions of environmental harshness and unpredictability in early childhood to later psychological functioning.

Darwin's theory of evolution by natural selection states that only a subset of those members of a species born will survive, resulting in competition for a set of limited resources. Given that variability exists among the population, those that have characteristics associated with greater survival will be able to pass on those features to their offspring. Over evolutionary time, these heritable variations change in frequency, eventually resulting in species-wide traits in the population.

Evolution by natural selection has been incredibly influential in the life science, and has more recently permeated the field of psychology. Evolutionary psychologists appreciated that natural selection can be applied to psychological mechanisms, with cognitive systems—just as with physical traits—evolving to solve specific problems of survival and reproduction (see Tooby & Cosmides, 1992 for a full discussion on evolutionary psychology). Owing to the significance of survival and mating, most of the focus of the literature regarding evolution and its application on human behavior and

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cognition has been on adults; however, natural selection has operated at all stages of the lifespan, and perhaps with special potency during infancy and childhood.

In this essay, we first briefly outline the tenets of evolutionary developmental psychology and go on to further examine how life-history theory can be informative in understanding developmental trajectories. More specifically, we examine how an evolutionary developmental psychological approach can be applied to the study of developmental psychopathology. We then discuss how these theories are being applied to better understand adolescent risk-taking behaviors, specifically by examining the unique influence of predictability and harshness in early environment and how the future of this field is in the application of life-history thinking to developmental questions.

EVOLUTIONARY DEVELOPMENTAL PSYCHOLOGY

Evolutionary developmental psychology is the application of the basic principles of evolution by natural selection to explain contemporary human development, positing that because humans spend more of their lives as "pre-reproductives" than any other mammal, any adaptations that increase the chance of surviving to adulthood across development would be favored by natural selection (see Bjorklund & Pellegrini, 2002; Ellis & Bjorklund, 2005).

Evolutionary developmental psychology adopts a developmental systems approach (Gottlieb, 2007), which postulates that all evolved characteristics develop via continuous and bidirectional gene–environment interactions that emerge dynamically over time (see Figure 1). From this perspective, all development is the product of epigenesis, the emergence of new structures and functions during the course of development via these complex interactions occurring among multiple levels. [In biology, epigenesis also refers to the influence of nongenetic factors on gene expression; see Jablonka and Lamb (2005)]. Evolutionary developmental psychology further proposes that development is constrained by both genetic and environmental factors. Individuals inherit a species-typical genome as well as a species-typical environment, allowing for newborns to be prepared by natural selection to "expect" certain types of environments and to process some information more easily than others. Lastly, evolutionary developmental psychology proposes that natural selection has produced specific adaptations of infancy and childhood—deferred, ontogenetic, and conditional adaptation.

Deferred adaptations are those selected for their role in preparing the child for adulthood. For example, sex differences in play styles have been identified as one such adaption. Girls exhibit relationship-based fantasy play, whereas boys exhibit more dominance-based fantasy play and more

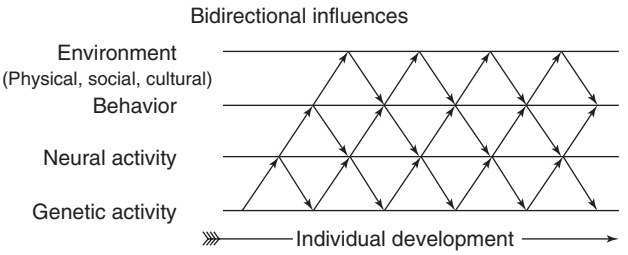

Figure 1 A simplified schematic of the developmental systems approach (*Source:* Gottlieb, G. (1991). Experiential canalization of behavioral development: Results. *Developmental Psychology, 27,* 35–39). This figure shows a hierarchy of four mutually interacting components. Activity at one level influences activity at adjacent levels. For instance, genetic activity may affect the generation or activation of neurons, which in turns affects how a person behaves. That behavior then has some outcome on the environment. The response of environment (e.g., how people respond to a child's action), in turn, influences behavior, which affects brain activity, which itself alters genetic activity (e.g., turns on or off a particular gene). The relationship between genes, behavior, and environment is thus bidirectional in nature (genes ↔ behavior ↔ environment).

rough-and-tumble play than girls (see Geary, 2009). Such sex differences during childhood prepared ancestral boys and girls (and likely contemporary children as well) for competing and cooperating with other members of their species in adulthood. In contrast, *ontogenetic adaptations* are those evolved characteristics specifically selected to help children survive at a specific time in development, and not to prepare them for adulthood. For example, newborn infants' tendency to copy the facial gestures of a model are not related to imitative behavior later in life, but serve to facilitate nursing or social interaction between an infant and its mother at a time when the infant has little intentional control of its behavior (see Byrne, 2005).

Conditional adaptations are evolved mechanisms that detect different characteristics in a child's environment and subsequently direct the course of development. This implies a high degree of plasticity across development (Boyce & Ellis, 2005). One of the most illustrious examples of such an adaptation was presented by Belsky, Steinberg, and Draper (1991) who examined how early rearing environment affected the rate at which children (especially girls) attain puberty and their future adult mating strategies. This line of reasoning is based on the proposition that children's early environments are reliable predictors of later environments. According to Belsky *et al*. (1991, p. 650), "a principal evolutionary function of early experience—the first 5–7 years—is to induce in the child an understanding of the availability and predictability of resources (broadly defined) in the environment, of the trustworthiness of others, and of the

enduringness of close interpersonal relationships, all of which will affect how the developing person apportions reproductive effort." Given that premise, they proposed an evolutionary theory of socialization, specifically examining the developmental trajectories of two substantially different environments. Belsky *et al*. (1991) proposed that children growing up in high-stress, low-resource, and unpredictable environments were likely to attain puberty, become sexually active, and reproduce earlier than children growing up in low-stress, high-resource, and predictable environments. Moreover, as adults, such children were predicted to have more offspring but invest less in them than children from more advantaged homes. This is a good reproductive strategy for children living in harsh and unpredictable environments, in that the probability of "success" for any single offspring they may have would be low, making the "reproduce early and often" strategy an adaptive one. Children growing up in more predictable and supportive environments, however, develop a contrasting reproductive strategy by postponing reproduction and investing heavily in their offspring.

Belsky *et al*.'s study (1991) was arguably the beginning of the new subfield of evolutionary developmental psychology, with roots in the then emerging life-history theory (See Ellis *et al*., 2012).

LIFE-HISTORY THEORY AND STRATEGIES

Life-history theory, rooted in evolutionary biology, seeks to explain differences in how organisms allocate their time and resources by studying the variations throughout the life course across species. Given that organisms cannot simultaneously maximize all aspects of evolutionary fitness, they are forced to make trade-offs between somatic efforts and reproductive efforts. Somatic efforts include growth, maintenance, brain development, and social learning. Reproductive efforts include attracting mates, gestation (for females), and parenting of offspring. Natural selection favors organisms that can successfully manage these trade-offs.

Across the life span, an organism must make many choices that relate to these life-history factors. The chain of resource-allocation decisions makes up that organism's life-history strategy. These strategies can essentially be summed up as the trade-offs between current or future reproduction, and quality or quantity of offspring (see Ellis, Figueredo, Brumbach, & Schlomer, 2009).

Although life-history strategies are species-typical adaptations to past ecological contexts, there are individual differences within a given species as a result of variation in those developmental and ecological contexts that alter the costs and benefits of the trade-offs. One key influence on the variation

of life-history strategies is extrinsic morbidity–mortality (or environmental harshness; Ellis *et al*., 2009), which describes the mortality rate and rates of nonlethal injuries, pathogen loads and diseases, and other form of stress in the local environment. Life-history theory states that it is adaptive to mate early, reproduce early, and have low parental investment in offspring when extrinsic morbidity–mortality is high, at the cost of growth or development. Similarly, it predicts that when morbidity–mortality is low, mating and reproduction will be postponed, high parental investment will be afforded once reproduction occurs, and the organism will take more time to develop physically and psychologically (Ellis *et al*., 2009). When taken together and put on a single continuum, these life-history strategies are anchored by r-selected, or fast life-history strategies, and K-selected, or slow life-history strategies, respectively.

In addition to extrinsic morbidity–mortality, unpredictability in the environment also influences the development of either r or K life-history strategies (Ellis *et al*., 2009). In environments that vary unpredictably, persisting in a slow life-history strategy is not adaptive because mating and reproduction opportunities are not guaranteed. Life-history theory predicts that an organism will be sensitive to predictability throughout development and will respond to signals of unpredictability by adopting a faster life-history strategy.

DIFFERENTIAL SUSCEPTIBILITY AND BIOLOGICAL SENSITIVITY TO CONTEXT

Informed by life-history theory, Belsky *et al*. (1991) proposed a *psychosocial acceleration theory*. As briefly mentioned earlier, Belsky *et al*. (1991) found that early developmental environment can regulate and predict later reproductive strategies. The theory postulated that experiences in early childhood affected children's somatic and behavioral development, which subsequently influences pubertal timing and reproductive strategies that serve to match an adaptive life-history strategy to the local ecology. Consistent with life-history theory and the influence of cumulative stress, strategies can be said to fall on a slow-fast continuum, ranging from higher stress [e.g., high marital discord, unstable employment, low socioeconomic status (SES)] to lower stress (e.g., low marital discord, stable employment, higher SES).

This theory later developed into the cornerstone for understanding *differential susceptibility*. Belsky and colleagues (2007; Belsky, 2005) proposed that some children are more sensitive (or differentially susceptible) to environmental influences. According to differential susceptibility, when

environments are unpredictable, children who are highly responsive to differences in the environment will be able to adjust to negative environments (e.g., absence of father), and will also do particularly well in positive environments. Conversely, other children are less susceptible to environmental cues and are more stable in their responsiveness. These children tend to thrive in a species-typical "expected" environment.

In a related theory, also drawing on life-history theory, Boyce and Ellis (2005; Ellis & Boyce, 2008) proposed a theory of *biological sensitivity to context*, which attempts to explain the adaptive relationship between early life experience and stress reactivity. It posits that early environment primes future stress reactivity, and that early experience with stress interacts with individual differences in children's genetic predispositions to sometimes produce adaptive long-term outcomes and other times produce maladaptive long-term outcomes. Adaptive phenotypic plasticity enables children to match their biological and behavioral systems to the parameters of their early (and predicted future) developmental environments. Those who are sensitive are impacted by their environment both *for better and for worse* relative to those who are less sensitive. Low-reactive children are sometimes referred to as dandelions owing to their analogous resiliency and ability to thrive in both negative and positive environments, whereas high-reactive children are likened to orchids, whose outcomes are highly dependent on very specific environmental settings and are highly sensitive to shifts in the environment.

In one illustrative study, Boyce *et al*. (1995) assessed the incidence of respiratory infection in 3- to 5-year-old children classified as either low or high in biological sensitivity to context on the basis of cardiovascular and immunologic reactivity. The incidence of respiratory infection did not vary with the stress levels of the homes for low-reactive children (see also Obradović, Bush, Stamperdahl, Adler, & Boyce, 2010). In contrast, for high-reactive children, those from low-stress homes had the lowest incidence of infections, whereas those who came from high-stress homes exhibited the highest rate.

AN EVOLUTIONARY DEVELOPMENTAL PSYCHOLOGICAL MODEL OF MENTAL HEALTH

Application of these differential sensitivity models can be seen in examinations of risky behavior in adolescents, an apt population for such an application, as adolescents are more likely than any other population to engage in risky behaviors (Steinberg, 2008). The mental-health model (also called diathesis-stress model) is the dominant scientific paradigm for explaining the relationship between detrimental, high-risk environments and subsequent outcomes. This paradigm adopts the view that

adverse, high-risk behavior promotes disturbances in subsequent development and asserts that certain individuals are predisposed to develop psychopathologic conditions when exposed to stressful environments. According to this model, "good" developmental outcomes, such as good mental health, secure attachment, emotional regulation, and educational success, tend to emerge from children who were reared in positive, supportive environments, whereas negative, stressful environments foster "bad" developmental outcomes, such as illness, insecure attachment, behavioral problems, drug use, depression, and early pregnancy. These observations direct the field of developmental psychopathology to focus strictly on the detrimental effects of familial and ecological stressors on mental-health outcomes (e.g., adolescent onset of psychopathology). The mental-health model emphasizes *costs* and largely ignores any potential *benefits* of children's responses to their local environments, making it difficult to explain children's and adolescents' motives for their behavior (see Del Giudice & Ellis, in press; Ellis *et al*., 2012; Ellis & Bjorklund, 2012). Negative mental-health outcomes are seen as a logical progression from exposure to harsh, unpredictable, or uncontrollable socioecological contexts. This leads to the view of children and adolescents' reactions (e.g., depression and conduct disorder in childhood, adolescent risk behavior) as inherently pathological.

In contrast to the mental-health model, an evolutionary developmental perspective asserts that humans have evolved to respond to different environmental contexts—good and bad—in an adaptive manner. It posits that development is not so much *disturbed* when exposed to negative, stressful environments, as it is *directed* or *regulated* toward attaining adaptive strategies to function in these stressful environment (see Del Giudice & Ellis, in press; Ellis *et al*., 2012). As stated by Ellis *et al*. (2012), "The evolutionary model posits that natural selection shaped our neurobiological mechanisms to detect and respond to the fitness-relevant costs and benefits afforded by different environments. Most important, these responses are not arbitrary but function adaptively to calibrate developmental and behavioral strategies to match those environments" (p. 600). It is important to note that although these adaptations may be harmful in modern societal terms, they are well designed to cope evolutionarily with the immediate environment (For elaboration on the naturalistic fallacy, see Teehan & diCarlo, 2004).

FUTURE DIRECTIONS: UNDERSTANDING RISKY ADOLESCENT BEHAVIOR

Adolescent behavior, including risky behavior, should, according to the evolutionary developmental model, be examined for potential fitness benefits as

well as costs. Risky adolescent behavior can easily be seen as maladaptive, in that high-risk behaviors can result in significant harm to a person's life expectancy and welfare (Ellis *et al*., 2012), but taking risks can be beneficial in some situations. The following sections will outline two lines of research that we believe are the future of how an evolutionary developmental perspective can be applied. We first discuss how this evolutionarily informed perspective can help explain an age-long developmental problem, bullying. We then go on to elaborate on how identifying the variables that may have unique contributions to help understand life-history outcomes.

Understanding Bullying

Antisocial behavior such as bullying is highly frowned upon in modern society, but is a common animal behavior that has the ability to increase access to resources, such as food, social status, and mates (Hawley, 1999; Volk, Camilleri, Dane, & Marini, 2012). *Resource control theory* (Hawley, 1999) states that such antisocial behavior serves to control resources in the environment, and that there are three classes of resource control strategies that can produce a variety of different antisocial behaviors. *Prosocial controllers* are mainly cooperative, working with those in their environment to gain and maintain access to resources. Prosocial controllers are typically friendly, socially proficient, and liked by their peers. *Coercive controllers*, on the other hand, are aggressive and antagonistic in their resource control. They are typically disliked by their peers, are socially inept and rejected, and seen as impulsive and aggressive. *Bistrategic controllers*, in contrast, use both cooperative and coercive behaviors in order to gain resources. They are typically socially skilled and well-liked, but are also aggressive. As stated by Ellis *et al*. (2012), "This combination of skills balanced with aggression—unexpected from a developmental psychopathology perspective—appears to capture an important dualism of human nature: the need to balance getting along and getting ahead" (p. 606).

Consistent with this perspective, aggressive behaviors can be used strategically along with prosocial behaviors to attain resources, while maintaining a positive social standing. Bullying, a subtype of aggressive, coercive behavior, which peaks at adolescence and is seen cross-culturally, has been found to be associated with average or above-average mental health, peer popularity, and social skills (see Bjorklund & Hawley, 2014). Furthermore, the adaptive benefits of bullying are apparent by data showing that adolescents identified as bullies tend to date more and at an earlier age than their nonbully counterparts (Gallup, O'Brien, & Wilson, 2011). Thus, counter to the belief that bullies are socially rejected and psychologically maladjusted, at least some

bullies experience good mental health and gain real benefits from their hurtful actions, including high social standing.

Research stemming from this evolutionary developmental perspective of social dominance has the ability to shed additional light on the different personality variables or social hierarchy constructs that promote different types of controllers. It can also serve to better inform intervention programs geared toward reducing instances of bullying, as the interventions for coercive controllers are unlikely to be effective for bistrategic controllers given the differences in motivation and targets.

Examining the Influences of Early Unpredictability and Harshness

The evolutionary perspective described thus far implies that development has been shaped by natural selection to be responsive to different environmental condition. As already discussed, early rearing conditions are particularly crucial in understanding behaviors later in development (Belsky *et al*., 1991) and the formation of life-history strategies (Ellis *et al*., 2009). In a recent within- and between-species analysis guided by life-history theory, Ellis et al. (2009) proposed that the key dimensions of the environment that organisms are sensitive to are *harshness* and *unpredictability*. As stated earlier, environmental harshness (also referred to as extrinsic morbidity–mortality) refers to the rate at which extrinsic factors cause death or some disability across the population (e.g., pathogen load, lethal and nonlethal injuries). Harshness is typically measured using SES, given the linear relationship between low SES and high mortality and morbidity. Unpredictability in the environment refers to stochastic variation in salient environmental factors, such as frequent and unpredictable changes in geography, family composition, and parental behavior. Unpredictability is typically measured by indicators such as frequent residential changes, parental divorce, and remarriage.

In an attempt to understand the unique contribution of environmental harshness and unpredictability to variations in life-history strategies, Belsky, Schlomer, and Ellis (2012) tested a model proposing that high levels of unpredictability and environmental harshness, specifically in the first 5 years of a child's life, will independently predict an accelerated life-history strategy. In their study, environmental harshness was defined as income-to-needs ratio and unpredictability as, collectively, residential and paternal transitions, and parental job changes. They hypothesized that a lower income-to-needs ratio along with high unpredictability in the first 5 years of the child's life will independently predict higher depressive symptoms in the mother, which in turn will predict lower levels of maternal sensitivity, thereby resulting in an accelerated life-history trajectory. They found that unpredictability of a

child's environment in the first 5 years was a unique and direct predictor of having greater number of sexual partners at 15 years of age, an indicator of an accelerated life-history strategy. They also found that while early harshness was a significant predictor, it had a greater indirect, rather than direct, effect.

Simpson, Griskevicius, Kuo, Sung, and Collins (2012) examined how harshness and unpredictability during early childhood (0–5 years) and later childhood (6–16 years) predicted risky behavior at age 23, including aggression and delinquency (based on self-report scales), involvement in criminal behavior, age of sexual debut, and number of sexual partners. They predicted that exposure to unpredictability would uniquely and directly predict faster life-history outcomes, independent of environmental harshness. They also predicted that exposure to these variables would have a more direct effect on adult outcomes and be more influential in the first 5 years of life rather than in later childhood. Simpson *et al*. (2012) reported that unpredictability in the first 5 years of childhood was the strongest independent predictor of an accelerated life-history strategy, by having more sexual partners, earlier sexual debut, and having higher levels of aggression, risk-taking, and delinquent behaviors. As expected, exposure to harshness and unpredictability in later childhood (6- to 16-years old) were not significant predictors of these life-history outcomes.

These findings suggest that an unstable environment, with unpredictable changes through the first 5 years of life, highly influences children's developmental trajectory. From an evolutionary developmental perspective, adolescents and young adults exhibiting risk taking and early sexual promiscuity are simply responding with adaptive behaviors that are best suited for their environmental context, cued by their experiences during their first 5 years of life.

Although these findings are robust, this subfield is only beginning to blossom. Future directions can serve to identify different types of stress that may be uniquely related to certain life-history outcomes. In addition, genes play a central role in the evolution of behavior as well as its expression over the course of a lifetime, but genes are always expressed in an environment that determines which genes get expressed, when, and the degree to which they are activated. Therefore, identifying gene–environment correlations could serve to be valuable for predicting different risk-taking outcomes.

CONCLUSION

Evolutionary thinking is relatively new to mainstream psychology, particularly psychology dealing with pathological behavior. Not long ago, scholars

and mental-health practitioners saw no benefit in taking an evolutionary perspective, assuming that evolution by natural selection involves a form of genetic determinism. If it evolved, it is in the genes and there is not all that much that can be done about it. Furthermore, natural selection is responsible for species-typical and universal features, and psychopathology, by definition, represents deviations from the species norm. Such viewpoints, however, do not reflect modern evolutionary biology or psychology. Environments over the course of infancy and childhood can affect the ontogenetic trajectory of a child, with different stable environments producing different outcomes for the same genotype. In other words, there is much plasticity in development, and, although this is counter to an evolutionary perspective that proposes that genes determine behavior (genes → behavior), it is compatible with an evolutionary approach that views development (and evolution) as occurring via the bidirectional relationship between and genes and behavior (genes ↔ behavior). From this perspective, developmental plasticity is an evolved characteristic of human cognition and behavior, not an exception to an evolutionary rule.

However, plasticity is not unbounded. In fact, children have apparently evolved to be sensitive to ecological conditions early in life, which are good (although not perfect) predictors of what conditions will be later in life. Children's development in response to these early environments is thus not random, but constrained, moving children in a direction that has proved adaptive to generations of their ancestors growing up in similar conditions. Some of these outcomes are viewed as maladaptive in contemporary environments, such as increased risk taking in adolescents and young adults that can result in addiction, unwanted pregnancy, sexually transmitted diseases, criminal behavior, and even death. Yet, despite these obvious negative outcomes for young people and society, such high-risk behavior may have been adaptive for our ancestors growing up in harsh and unpredictable environments. If relationships are unreliable and unstable, resources limited and unpredictable, and the likelihood of a long and prosperous life uncertain, taking risks may be the only way to increase the chance that one will get his or her genes into the next generation. Even for today's youth, the maladaptive outcomes associated with high-risk behaviors may be worth it. Rather than viewing them as pathological and maladaptive, we should view them as evolved, alternative paths to resource acquisition and mating opportunities. This does not mean that we, as a society, must "accept" or condone such often-destructive behavior. However, by taking an evolutionary developmental perspective, we can see that such behaviors are not aberrations of normal behavior, but are biologically reasonable responses to harsh and unpredictable environments. Taking such a perspective will not, of course, make the problems caused

by delinquent adolescents go away; but it will influence how we view the perpetrators of such high-risk behaviors and the solutions we develop to minimize the harm these behaviors and individuals cause.

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