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Developmental Dynamics and Contemporary Evolutionary Psychology: Status Quo or Irreconcilable Views? Reply to Bjorklund (2003), Krebs (2003), Buss and Reeve (2003), Crawford (2003), and Tooby et al. (2003)

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The authors address commentaries by D. F. Bjorklund (2003); D. M. Buss and H. K. Reeve (2003); C. B. Crawford (2003); D. L. Krebs (2003); and J. Tooby, L. Cosmides, and H. C. Barrett (2003) on their analysis of the underlying assumptions of contemporary evolutionary psychology (R. Lickliter & H. Honeycutt, 2003). The authors argue that evolutionary psychology currently offers no coherent framework for how to integrate genetic, environmental, and experiential factors into a theory of behavioral or cognitive phenotypes. The authors propose that this absence is due to a lack of developmental analysis in the major works of evolutionary psychology, resulting in an almost exclusive focus on adaptationist accounts of evolution by natural selection rather than a more broad-based focus on the process and products of evolution by epigenetic developmental dynamics.

The commentators on our article (Lickliter & Honeycutt, 2003) raised a number of important issues, and several of their reactions are likely shared by other researchers attempting to integrate evolutionary thinking into the psychological sciences. Two general themes reappeared across the commentaries (Bjorklund, 2003; Buss & Reeve, 2003; Crawford, 2003; D. L. Krebs, 2003; Tooby, Cosmides, & Barrett, 2003): (a) Although development is acknowledged to be important in the achievement of phenotypic traits and characters, our critics argued that incorporating a developmental dynamics perspective will not substantially change the aims, methods, or concerns of evolutionary psychology—in other words, there is nothing in the developmental dynamics approach outlined in our article that is not consistent with the basic premises of evolutionary psychology, and (b) evolutionary psychologists are not predeterminists—they are fully aware that any phenotype depends on interactions between a genome and an environment, and we have thus addressed a straw man in our critical examination of evolutionary psychology's underlying assumptions. Our critics argued that we have constructed and deconstructed a framework for evolutionary psychology that no current practitioner would endorse.

In what follows we propose that the comments on our article (Lickliter & Honeycutt, 2003) provide further evidence that the prespecified, instructionistic approach to understanding human development and evolution we highlighted is alive and well in evolutionary psychology. Furthermore, we reemphasize that evolutionary psychology currently offers no coherent framework for how to integrate genetic and experiential factors into a theory of the phenotype. We argue that this absence is due in large part to a lack of developmental analysis in the major works of evolutionary psychology, resulting in an almost exclusive focus on adaptationist accounts of evolution by natural selection rather than a more broad-based focus on the process and products of evolution by developmental mechanisms. Our primary thesis is that the prespecified, nondevelopmental approach to evolution (implicitly or explicitly) espoused by evolutionary psychologists is not consistent with recent findings from the life sciences and therefore will ultimately fail to provide a plausible explanatory framework for understanding human behavior and development.

The Relevance of Development to Evolutionary Issues

One position shared among the commentators is that although an appreciation of development is important, any changes that would occur to evolutionary psychology by accepting a probabilistic epigenetic view of development would either be irrelevant (Crawford, 2003; D. L. Krebs, 2003) or would not significantly alter the basic aims and current focus of evolutionary psychology (Bjorklund, 2003; Buss & Reeve, 2003; Tooby et al., 2003). We strongly disagree with these views. As recently pointed out by a number of biologists, psychologists, and philosophers, development and evolution can effectively be viewed as two sides of the same coin. The mechanisms of evolution are now considered to be essential to understanding development, and the mechanisms of development have likewise become essential to understanding evolution (e.g., Gilbert, 2000; Kirschner & Gerhart, 1998; Moss, 2003; Oyama, Griffiths, & Gray, 2001). This is the case because all phenotypic traits and characters arise during ontogeny as products of individual development. In other words, traits or characters (be they behavioral, cognitive, or otherwise) must be generated in individual ontogeny, regardless of whether they have an evolutionary history. As we pointed out in our article (Lickliter &

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Honeycutt, 2003), evolutionary change primarily occurs by variation in the patterns of development that give rise to individual phenotypes. Development is thus a key factor in understanding evolution and its outcomes (see Alberch, 1982; Gottlieb, 1992; Oyama, 1985, for further discussion). This is not a new message. Writing over 60 years ago, the embryologist and geneticist Conrad Waddington (1941) argued that

> a theory of evolution requires, as a fundamental part of it, some theory of development. Evolution is concerned with changes in animals, and it is impossible profitably to discuss changes in a system unless one has some picture of what the system is like. Since every aspect of an animal is a product of development, or rather is a temporary phase of a continuous process of development, a model of the nature of animal organization can only be given in developmental terms. (p. 108)

As we reviewed in our article (Lickliter & Honeycutt, 2003), development guides and constrains evolution in at least two major ways: First, it constrains phenotypic variation in such a way that the traits and characters presented to the filter of natural selection are not random. This is the *regulatory* function of development. Second, development provides variants in traits and characters that may lead to enduring alterations of the phenotype. This production of phenotypic novelties is the *generative* function of development and has significant implications for evolutionary change (see Gottlieb, 1992, 2002). Recent evidence from embryology, developmental biology, and developmental psychology makes clear that the regulatory and generative nature of development renders the natural selection of random mutations (the cornerstone of the neo-Darwinian view of evolutionary change) insufficient to account for evolution and its outcomes. Rather, the individual organism's developmental system is the source of both the stability and the variations in phenotype that researchers in evolutionary biology and developmental psychology seek to better understand. This insight was a primary theme of our article and stands in contrast to the widespread assumption in evolutionary psychology that ontogeny and phylogeny can be alternative processes by which information is made available to developing individuals.

The interdependence of development and evolution has emerged as a dominant theme in the life sciences in the beginning of the 21st century and, as we highlighted in our article, is leading to significant shifts in thinking about how to define genes (e.g., Keller, 2000; Moss, 2003), how to characterize heredity (e.g., Jablonka, 2001; Oyama et al., 2001; Raff, 1996), and how to attribute the role of natural selection in evolutionary change (e.g., Gottlieb, 1998; Gould, 2002), to mention only a few examples. The growing appreciation of the interdependence of development and evolution is also evident in the establishment of several new subdisciplines within biology, including evolutionary developmental biology. This "evo-devo" approach aims to integrate development and evolution in a coherent theory (Hall, 1999). Despite the growing effort to integrate development into evolutionary biology, we find no meaningful analysis of development in the major works defining evolutionary psychology (Tooby et al.'s, 2003, comments not withstanding), and our target article was designed in large part to offer a corrective to the nondevelopmental view of evolution that has been given to psychology by evolutionary psychologists. Bjorklund (2003) appreciated the importance of this effort in his commentary, but Buss and Reeve (2003), Crawford (2003), and D. L. Krebs (2003) remained unconvinced that developmental analysis has much to offer the primary aims or concerns of evolutionary psychologists.

The Role of Natural Selection in Evolutionary Theory

We suspect that this ambivalence is due to the fact that evolutionary psychologists emphasize evolution by natural selection as opposed to evolution by epigenetic developmental mechanisms (Crawford, 2003; Tooby et al., 2003). In their commitment to adaptationism, most evolutionary psychologists continue to hold that natural selection, presumably operating on random mutations and genetic drift, is the creative force behind the design of a wide range of human behavioral and cognitive traits. In sharp contrast to this line of thinking, we argued that it is changes in development that are responsible for generating novel phenotypes, which must then pass through the filter of natural selection (Lickliter & Honeycutt, 2003). As Bjorklund (2003) pointed out in his commentary, natural selection is the "gatekeeper" (p. 840) of evolutionary change by eliminating those phenotypes that do not fit well with their environments—it is not the creative "generator" (p. 840) of phenotypic form or phenotypic change. Simply put, natural selection is the filter that preserves reproductively successful phenotypes, which are themselves the product of individual development (Gottlieb, 2000). Tooby et al. (2003) came close to endorsing this view in their commentary, but fell short by continuing to speak of natural selection "for" traits. Natural selection does not select for phenotypic traits, as it has no agency. Rather, natural selection selects "against" individual organisms exhibiting (or lacking) specific traits or characters. Tooby et al. (2003) went on to argue that natural selection drives evolutionary processes because "it is natural selection that chooses some genes rather than others" (p. 863). In keeping with contemporary developmental systems theory, we emphasized that natural selection acts on phenotypes, not genotypes.

This view of the role of natural selection is at odds with much of the conceptual foundation of contemporary evolutionary psychology. For example, in their primer for evolutionary psychology Cosmides and Tooby (1997) proposed that

> generation after generation, for more than 10 million years, natural selection slowly sculpted the human brain, favoring circuitry that was good at solving the day-to-day problems of our hunter–gatherer ancestors. . . . Natural selection is a slow process, and there just haven't been enough generations for it to design circuits that are well-adapted to our post-industrial life. (p. 12)

This perspective led Cosmides and Tooby (1997) to propose that "behavior in the *present* is generated by information-processing mechanisms that exist because they solved adaptive problems in the *past*—in the ancestral environments in which the human line evolved" (p. 12). Evolutionary psychologists thus attempt to explain humans' modern behavioral and cognitive phenotypes by honing in on the problems our ancestors faced in the origins of the species. Thanks to design by natural selection, the minds of modern humans are seen to come equipped with predesigned domain-specific solutions (via cognitive modules) for these problems. Use of this type of phylogenetic explanation for the origins and underlying essence of human behavior and cognition is apparent across the commentaries. For example, Crawford (2003) argued that "organisms develop on the basis of many sources of information.

One source is information about ancestral environments that is encoded in DNA" (p. 857). This phylogenetic basis of human nature is misleading and misplaced, however, as humans' behavioral and cognitive capacities are not encoded or prespecified but rather continue to evolve alongside the conditions of development (Ingold, 2002; Richardson, 1998).

As a result, we argued that the mere passing on of a genome cannot serve as a sufficient explanation for the achievement of any behavioral or cognitive outcome, although it is certainly a necessary one (Lickliter & Honeycutt, 2003). Bjorklund (2003) and Tooby et al. (2003) appeared to agree with this view. We emphasized throughout our article that phenotypic traits are generated, not expressed, in development. In the language of developmental dynamics, form is an emergent property of the entire field of relationships within which the organism comes into being (e.g., genes, cytoplasm, neurons, hormones, diet, conspecifics). This dynamic and contingent account of trait generation underscores the key insight that understanding the mechanisms of development and evolution requires a relational concept of causality (see Gottlieb & Halpern, 2002). The influence of genes, neuronal architecture, the physical surround, or any other factor in development can be understood only in relation to the developmental system of which they are part. Control for developmental outcomes thus resides in the structure and nature of relationships between factors or variables, not in individual variables themselves. Despite the various arguments to the contrary by our commentators, we find the application of this insight to be absent in nearly all works of evolutionary psychology. We argued that its incorporation into the field's conceptual framework would significantly alter the nature and extent of evolutionary psychology's explanations for human behavior and development. In particular, such a shift in how to attribute causation (see White, 1990) should guide evolutionary psychology to develop a more coherent framework for how to integrate genetic and experiential factors into a theory of the phenotype. Tooby et al.'s comments suggest that this agenda is beginning to receive attention within the field. We proposed that such an effort requires a multilevel framework linking genetic, neurobiological, behavioral, cognitive, social, and cultural levels and time scales to discover the relations between interactive processes making up the organism's developmental system (see Cacioppo, Bernston, Sheridan, & McClintock, 2000; Li, 2003, for similar arguments).

Relying on Prespecification: Not a Straw Man

A second theme shared across the commentaries is that we have mischaracterized the foundational premises guiding evolutionary psychology (in particular, see Buss & Reeve, 2003; D. L. Krebs, 2003; Tooby et al., 2003). Our commentators argued that we have constructed a straw-man version of the field that no current practitioner would endorse and that as a result, our critical examination of the underlying assumptions of evolutionary psychology is both flawed and counterproductive to advancing the field. In response to these claims, we argue that the commentaries themselves provide a number of cogent examples of the underlying assumptions we took to task in our article (Lickliter & Honeycutt, 2003), including the widespread notion of *prespecification*, that phylogenetic information is somehow encoded in the genes and unfolds in the course of individual development. This view of the organism, whose essential nature and cognitive architecture is thought to be largely prespecified in advance of its development in the world, remains an underlying premise across much of evolutionary psychology. For example, Tooby and Cosmides (1989) have argued for the "innate foundation of the psyche" (p. 40). This view rests on the assumption that for any particular individual, there is some way in which information specifying its development can get into the organism before its development occurs (Ingold, 2002; Lickliter & Berry, 1990). Thus, we have D. L. Krebs (2003) speaking of "recipes from genes" (p. 845) and Buss and Reeve (2003) discussing "evolved decision rules that influence which behaviors are produced in different ecological contexts" (p. 851). We have Crawford (2003) arguing for "genetically coded developmental processes that were designed by natural selection" (p. 856) and Bjorklund (2003) calling into play "evolved information-processing mechanisms, presumably represented in the genes" (p. 837).

Evolutionary psychologists do not, however, directly concern themselves with genes—the genome is an object of reference, it is not an object of study. The use of instructionistic phrases such as "recipes from genes" (D. L. Krebs, 2003, p. 845) or "encoded in the DNA" (Crawford, 2003, p. 857) by our commentators are simply intended to make the point that genetic factors are thought to predispose organisms to behave or learn or think in a particular way (see Bjorklund, 2003). This notion is an example of the phylogeny fallacy discussed in the target article (Lickliter & Honeycutt, 2003), in which it is assumed (often implicitly) that the phenotypic traits of an individual, including significant aspects of his or her behavior and cognition, can be determined by historical events that designed the individual's genetic "program" or by environmental factors that act on the individual during his or her development. Far from being a straw man, the phylogeny fallacy is common currency in several areas within behavioral and cognitive science and remains a key construct of contemporary evolutionary psychology (Crawford & Krebs, 1998; Gaulin & McBurney, 2002). Although most evolutionary psychologists (including our commentators) claim to be interactionists because they acknowledge the importance of both genetic and environmental factors to understanding phenotypic development, the form of interactionism represented in the comments of Bjorklund (2003), Buss and Reeve (2003), Crawford (2003), and D. L. Krebs (2003) is a form of weak interactionism (Lerner, 2002) in which phenotypic development is seen to reflect the additive operation of two separate sources of information: one that is internal, formative, and relatively fixed (genetic) and one that is external, supportive, and relatively variable (environmental). Buss and Reeve denied the use of such dichotomous thinking in evolutionary psychology, but we find abundant evidence of it in the literature and in the commentaries themselves.

In particular, we found the comments of Tooby et al. (2003) to provide a cogent illustration of the dichotomous form of interactionism highlighted above. Their framework for the transgenerational stability of phenotypic traits and characters is based on two sets of determinants, a genetic and an environmental inheritance system. These two systems of inheritance are thought to jointly determine development. In this scheme, natural selection is seen to orchestrate the interaction between these two inheritances so that high degrees of functional order can emerge and persist across generations. According to Tooby et al., the environmental system

is inherited by default, by virtue of simply enduring across generations, whereas the genetic system is reproduced and transmitted. Failures of reliable phenotypic development are thus attributed to either genetic mutation or environmental change (or both). We see this dual inheritance approach and its reliance on prespecification as just the type of interactionism we argued against in our article (Lickliter & Honeycutt, 2003). We proposed that development is a self-organizing, probabilistic process in which pattern and order emerge and change as a result of transactions among developmentally relevant resources both internal and external to the organism (and not from some set of prespecified instructions). Development is not the result of the interaction of genetic and environmental factors, as neither operate as independent causes; rather, development results from the bidirectional and dynamic transaction of genes, cells, tissues, organs, and organisms during the course of individual ontogeny. Thus, genes and environment cannot be alternative or independent causes (or separate inheritance systems) for the expression of a trait or characteristic (see Wolf, 1995, for further discussion). What is inherited in reproduction is a developmental system, a complex of coacting influences, some internal (genes, cellular machinery, hormones) and some external (parental care, diet, interactions with conspecifics) to the individual organism.

We believe the persistence of dichotomous thinking in evolutionary psychology is due in large part to the continued acceptance of the distinction between proximate and ultimate cause, a hallmark of the adaptationist framework (see D. L. Krebs, 2003). In the general sense, proximate causes are seen as those acting during the life of the organism, whereas ultimate causes are characterized as those acting before the organism was conceived and that shaped its genome (Francis, 1990; Mayr, 1961). As pointed out by Crawford (2003), evolutionary psychology is primarily concerned with the ultimate causation of behavior and therefore focuses on its function or adaptive value with the aim of understanding how the behavior was designed or shaped by natural selection (J. R. Krebs & Davies, 1978). In keeping with earlier criticisms of this functionalist approach to behavior (e.g., Jamieson, 1986; O'Grady, 1984), we argued that a developmental dynamics approach offers a more comprehensive understanding of human behavior by abandoning the proximate–ultimate distinction in favor of an explicit concern with the epigenetic processes of development within and between generations (Lickliter & Honeycutt, 2003). Contrary to the suggestions of Crawford (2003) and D. L. Krebs (2003), this approach does not deny the role (or importance) of genes in the generation of phenotypic traits and characteristics, but it does argue against any notions of the simple passing on of adaptive behaviors or cognitive strategies to the next generation. In this light, we applaud Tooby et al.'s (2003) attempt to move beyond the conceptual inadequacy of genetic programs for development. However, we find their application of "developmental" programs to be lacking as well.

We proposed that a focus on the ontogenetic construction of phenotypes, in which the organism coactively constructs itself in each generation in relation to its internal and external environment, undermines any meaningful distinction between proximate and ultimate causes of phenotypic development (Lickliter & Honeycutt, 2003). Buss and Reeve (2003) and D. L. Krebs (2003) suggested that it is our failure to recognize the distinction between developmental accounts (proximate cause) and functional explanations (ultimate cause) of phenotypes that undermines our criticisms of the foundational premises of evolutionary psychology. We maintain that our rejection of this distinction is a key basis for our arguments against the underlying assumptions of most evolutionary psychologists.

On a related note, Crawford (2003) cited evidence of a particular gene (*ey*, or eyeless) that contributes to the development of eyes even when substituted between mice and fruit flies. Rather than incensing developmental systems theorists such as ourselves, we find such findings of homology to be especially interesting, but unlike Crawford we do not see such instances as reflecting the immortality of genes. There are numerous examples in which homologous genes have been identified that are shared across species that lead to nonhomologous morphological features, and likewise there are numerous instances in which homologous morphologies involve the expression of nonhomologous genes (Wray & Abouheif, 1998). We do not see evidence from studies of gene substitution as support for assigning causal primacy to genes. For instance, when a mouse *ey* gene is substituted into a fruit fly, a fruit fly eye develops, not a mouse eye (Gehring, 1998). Furthermore, *ey* mutant flies, which have no eyes, eventually regenerate eyes when they are allowed to breed for several generations. In addition, studies using targeted gene knockouts often find no apparent phenotypic effects, even in situations in which the genes that were targeted are known to play an important (and presumably necessary) role in phenotypic expression (S. Rose, 1999). We see such findings as providing further support for the insight that the control for any phenotypic outcome is distributed across a developmental system of components and resources, of which genes are an important part.

Crawford (2003) is mistaken to believe that when a gene has been identified to be necessary for the actualization of a given phenotypic outcome that the causal pathway begins or ends with this gene (see Robert, 2001, for further discussion). A large number of components and processes must be organized and put in motion for a gene to function at all. As we emphasized throughout our target article (Lickliter & Honeycutt, 2003), genes are a crucial part of the developmental system, but causality is distributed across the developmental system. D. L. Krebs (2003) claimed we humans would not exist without genes—the same can be said for other developmentally necessary components such as cytoplasm, cell walls, and conspecifics.

Evaluating the Methods and Accomplishments of Evolutionary Psychology

Buss and Reeve (2003) proposed that evolutionary psychology should be evaluated on the grounds that the discipline has led to new domains of research, has generated a "rich empirical harvest" (p. 849), offers more parsimonious explanations of existing observations, and provides specific predictions in regards to undiscovered phenomena. In our view, Buss and Reeve (and Tooby et al., 2003) significantly overstated the scientific accomplishments of evolutionary psychology. Has evolutionary psychology really led to new domains of research? Certainly the domains of social exchange, social conflict, family interactions, morality, aggression, and so on listed by Buss and Reeve do not represent new topics of research in psychology. Each of these topics has a long and rich history in the behavioral sciences. What evolutionary psychology

had added are new measures and new explanations within these domains. From an evolutionary psychologist's point of view, psychologists have traditionally been blind to the extent of how natural selection has furnished human beings' minds (Cosmides & Tooby, 1997) and thus argue that a more concerted focus on evolved psychological mechanisms designed by natural selection will enhance explanations of human behavior and cognition and stimulate more fruitful research questions and more specific predictions than traditional psychological inquiry (Buss & Reeve, 2003; Tooby et al., 2003).

Evolutionary psychology has certainly generated a great deal of attention within and beyond the scientific community. Within the scientific community, the "rich empirical harvest" (p. 849) to which Buss and Reeve (2003) referred should be evaluated as much on the quality of its content as on its amount. In this light, we think it important to consider a separate empirical harvest in contemporary psychological sciences that calls into question the reliability and validity of much of evolutionary psychology's empirical base and methodology. For instance, in a recent review of empirical findings, Miller, Putcha-Bhagavatula, and Pedersen (2002) found no support for the claim that men and women have evolved distinct mating preferences and strategies. DeSteno, Bartlett, Braverman, and Salovey (2002) likewise found no evidence to support the claim of sex-related differences in jealousy. Both Miller et al. and DeSteno et al. proposed and provided empirical evidence in support of the view that evolutionary psychology's meta-theory of human behavior and cognition is wrought with confounding variables and measurement artifact. Similar problems have been identified in other areas as well. Much of the empirical foundation for establishing the existence of evolved, domain-specific reasoning mechanisms (e.g., the social contract algorithm and cheater-detection module) is based on findings generated using Wason's selection task (e.g., Cosmides, 1989; Fiddick, Cosmides, & Tooby, 2000). However, reexamination of the data from studies using this task has suggested that performance on the Wason task is highly content dependent and represents a potential case of experimental artifact (Fodor, 2000; Sperber, Cara, & Girotto, 1995; Sperber & Girotto, 2002).

Aside from these measurement and reliability issues, we find the validity of evolutionary psychology's claims to be lacking in at least three additional ways. First, although practitioners of evolutionary psychology claim to have identified evolved cognitive modules that have been designed by natural selection, these arguments are predominately based on data generated by interviews, surveys, and questionnaires. Evolutionary psychologists rarely validate their measures, however. For example, Buss (1995) claimed that natural selection favored women who preferred men with greater resources over those with fewer resources but presented no data to show whether mating with a wealthier man actually leads to more viable or "fitter" offspring in modern contexts or in the contexts of our distant relatives (see Fausto-Sterling, 1997). Without such empirical validation, how is one to know whether the responses of subjects on such paper-and-pencil tests really reflect how people actually behave in real-world situations? Indeed, in cases in which evolutionary psychologists predict differences in how men and women respond to sexual infidelity, no differences between the sexes are found when subjects are asked to report on their own experiences with infidelity (Harris, 2003).

A second threat to validity stems from a wealth of counterfactual observations. As a case in point, Daly and Wilson (1988, 1999) claimed that humans (and other species) possess a cognitive module to love and protect genetic offspring and that during humans' evolutionary history it was likely adaptive for men to engage in infanticide of the offspring of their mate(s) that were not their biological offspring. In support of this thesis, Daly and Wilson (1988) presented evidence that children who grow up in a household with a stepfather are at a greater risk of abuse than those raised with their biological father. To their credit, Daly and Wilson (1999) acknowledged that their hypothesis has difficulty explaining why a majority of stepfathers do not abuse their children, but they ignored other potentially counterfactual evidence such as the lesser levels of abuse in families that adopt children (H. Rose, 2000).

A third problem of validity involves the use of domain-specific cognitive modules as the proposed evolved psychological mechanisms underlying human behavior and cognition. In our target article (Lickliter & Honeycutt, 2003) we argued that arguments for such mental modules are typically based on an outdated instructionistic view of development. We pointed out that the existence and operation of cognitive modules as explanatory mechanisms are also problematic because such modules are almost entirely inferred from the very behaviors they are invoked to explain (see Schlinger, 1996). As a result, in real-world situations one simply cannot identify which modules were guiding behavior until after the person has acted. If one accepts evolutionary psychology's claim that there are hundreds or even thousands of innate cognitive modules, then one is faced with the daunting task of characterizing the dynamics of how these modules relate to one another in real-world situations (Cervone, 2000). Given the complexity (and oftentimes ambiguity) of real-world encounters and contexts, no doubt multiple modules will often be activated (Tooby & Cosmides, 1992). But which modules will dominate others to gain control over behavioral strategies and responses? For example, if a man is bargaining for or purchasing a food item from a woman, will his cheater-detection module, food preference module, or any of the other modules involved in decision making or sexual behaviors take control of behavior? How is one to choose whether behavior is guided by a single module or an aggregate of modules (Davies, 1996)? Evolutionary psychology is effectively silent (apart from post hoc inference and speculation) on these related questions, in large part because of the absence of developmental analysis within the field.

If evolutionary psychology were to incorporate a developmental perspective (as suggested by Bjorklund, 2003, and Tooby et al., 2003), then we predict that research attention necessarily has to shift to include not only the outcomes of development (modularity) but also a direct concern with the formative and regulatory processes of development (modularization; see Karmiloff-Smith, 2000). From a developmental perspective, mental modules do not emerge de novo and in isolation from the surrounding structural-functional organization that characterizes living organisms and their specific physical and social environments. If there are domain-specific modules, they must differentiate out of the available structure of the organism and its actual experiences and activities in a structured environment. Only by knowing which mental modules lead to other modules (or become more specified) and the developmental conditions of these transformations can one

reach an explanatory or predictive understanding of the dynamics of cognitive and behavioral change. These types of concerns are at the heart of the developmental approach outlined in our article (Lickliter & Honeycutt, 2003).

Concluding Remarks

We conclude our response by briefly responding to the charge that a developmental dynamics approach to evolutionary issues holds no water to evolutionary psychology when evaluated by the criteria proposed by Buss and Reeve (2003; theoretical cogency, interdisciplinary consistency, and empirical harvest). We suggest that this comparison is largely irrelevant in light of the intent of our article (Lickliter & Honeycutt, 2003). We did not set out to provide a specific alternative to evolutionary psychology. Rather, we focused on exploring whether the conceptual framework for understanding development and evolution espoused by proponents of evolutionary psychology is outdated and implausible in light of recent advances in the biological sciences. We believe the evidence we reviewed provides a compelling basis for concluding that several of the foundational premises of contemporary evolutionary psychology are indeed questionable in this light. Although we agree in principle with Buss and Reeve (2003) and D. L. Krebs (2003) that science can advance by measuring the merits of two or more alternative or competing theories, if the usefulness of a theory (or in this case a meta-theory) can be called into question by the weight of available contradictory evidence, then a defined alternative hardly seems required to critically question the assumptions guiding current evolutionary thinking within psychology.

That being said, we did attempt to provide an initial outline of how to better approach the issues of behavioral development and evolution in our article (Lickliter & Honeycutt, 2003). Our suggestions centered on the value and dividends of focusing on the processes that characterize reproduction and heredity. To date, there is no overarching theory that adequately explains the breadth of hereditary processes (i.e., those processes and resources involved in contributing to enduring phenotypic stability across generations and to the generation of phenotypic novelty). We believe such a theory is attainable, but in our opinion it has yet to receive the empirical or theoretical attention it deserves (but see Gottlieb, 2002; Johnston & Gottlieb, 1990; Newman & Muller, 2000; Oyama et al., 2001; Schlichting & Pigliucci, 1998). Given that natural selection can only be invoked to explain the frequencies of traits in a population (and not why individual organisms have the traits they do), it seems clear that much is to be gained in evolutionary theory from a fuller understanding of how traits are generated and maintained in developmental processes. To quote Sober (1995),

> This is not because selection says nothing about individuals; on the contrary, given that individuals have various traits, selection explains why individuals are eliminated or not and why they reproduce to the degree they do. However, selection does not explain why individuals have their traits. The latter explanandum is properly addressed by describing the mechanism of heredity. (p. 396)

Our "alternative" to evolutionary psychology is thus one of description and experimentation with the goal of showing how one generation leads to (i.e., sets up the developmental conditions and resources for) the next. We argue that the developmental dynamics approach outlined in our article (Lickliter & Honeycutt, 2003) is well suited for this endeavor in that adequate explanations of phenotypic stability and variability must include reference to the experiential history of particular organisms developing in particular, historically situated contexts. In other words, understanding the persistence and change of phenotypic forms over time must include an empirical focus on the activities and resources that generate them. By explicitly not making a distinction between genetic and environmental systems of inheritance, a developmental dynamics approach can provide an evolutionary perspective of human behavior and cognition that moves beyond outdated notions of genetically or environmentally determined development. This agenda would entail a radical and explicitly developmental alternative to the current aims and methods of evolutionary psychology.

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