Commentary

Human Development 2016;59:235–241
DOI: 10.1159/000452289

Human Development

Prepared Is Not Preformed: Commentary on Witherington and Lickliter

David F. Bjorklund

Department of Psychology, Florida Atlantic University, Boca Raton, FL, USA

Keywords
Evolutionary developmental psychology · Developmental systems theory · Evolved probabilistic cognitive mechanisms

I know very well the problems associated with integrating development and evolution, and thus I applaud Witherington and Lickliter's articulate opus examining two such proposals to do just that – evolutionary developmental psychology (EDP) and relational developmental systems (DS) theory. Some of the major assumptions of developmental psychology, especially when viewed from the perspective of DS theory, and of evolutionary psychology, particularly as espoused in its early incarnations, are, on the surface, incompatible. Evolutionary psychology emerged from sociobiology in the 1980s and 1990s as psychologists adopted Darwinian and neo-Darwinian concepts, most notably natural selection, to explain human behavior from a functional, or adaptationist, perspective. Most evolutionary psychologists also adopted Richard Dawkins' [1976] gene's-eye-view of evolution, which gave the impression to many developmentalists of genetic determinism, an anathema to DS advocates. DS theory in psychology traces its roots to early developmental psychobiologists such as Schneirla [1957], Kuo [1967], and Lehrman [1970], and most recently Gottlieb [1987, 1992, 2007] and his theory of probabilistic epigenesis. The theorizing of philosophers such as Griffiths and Gray [1994, 2005] and Oyama [1985, 2000] has also been influential. For DS theorists, nothing is preformed; structure and organization emerge via the bidirectional transaction of ingredients at all levels of organization, from DNA through culture. Somewhat ironically perhaps, the hard DS approach replaces the organism with DS as the principal focus of natural selection, much as Richard Dawkins [1976] replaced the organism with the gene in his selfish gene theory. In both cases, the organism is no longer a theoretically important entity in evolution [Pradeu, 2010].

KARGER
E-Mail karger@karger.com
www.karger.com/hde

0018–716X/16/0594–0235$39.50/0

David F. Bjorklund
Department of Psychology
Florida Atlantic University
Boca Raton, FL 33431 (USA)
E-Mail dbjorklu@fau.edu

Witherington and Lickliter present a well-researched and scholarly paper, first reviewing the central tenets of EDP, which purports to integrate Darwinian evolutionary theory with DS theory. The authors argue that EDP fails at this integration, primarily because it maintains an adaptationist/Darwinian perspective of causation and thus necessarily fails to reflect a true DS theory of emergence. The authors claim that developmental and evolutionary perspectives are ontologically incompatible and only a revolutionarily new model will be able to provide an adequate integration of evolution and development, one that focuses on formal and final causation rather than efficient causation.

At one level, I can find little to object to in Witherington and Lickliter's thorough review and theoretical presentation. I believe they present a fair and mostly accurate description of EDP's attempted integration of evolution and development and the differences in how EDP views DS theory and their own view of DS (shared by others such as Lerner and Overton). They then present their own interpretation of how development and evolution can be integrated, following Overton's [2015; Overton & Lerner, 2012] relational DS theory. This is all well and good and should be read by anyone interested in the integration of evolution and psychological development. However, the shortcoming of their approach, I believe, is their view that they are advocating *the* DS theory, and that the perspective taken by EDP is not only different from their own, but also conceptually wrongheaded and simply incorrect.

Witherington and Lickliter acknowledge that variation does exist among DS theorists [Oyama, 2009], but such acceptable variation does not extend to the variant of DS theory proposed by EDP theorists. In contrast to Witherington and Lickliter, a number of psychologists and philosophers have suggested there are two major forms of DS theory [Frankenhuis, Panchanathan, & Barrett, 2013; Pradeu, 2010; Robert, Hall, & Olson, 2001], a "hard" version and a "soft" version, and, without naming it, it is against EDP's adoption of the soft version that Witherington and Lickliter inveigh.

"Soft" versus "Hard" DS Theory

All DS theorists view the interaction (or transaction) of ingredients at all levels of organization, from genes through culture, as producing emergent structure and function in development. Genes are merely part of complex DS, a necessary but not sufficient component for development. Individuals inherit not only a species-typical genome and epigenome, but also a species-typical environment, which, in interaction, produce (usually) species-typical morphology and behavior. With respect to evolution, development provides the creative force for phenotypic novelties, and what evolved are DS of which genes are only a part.

Within this emergent system of bidirectional effects, at least two major types of DS theory exist [see Frankenhuis et al., 2013; Pradeu, 2010; Robert et al., 2001]. In the hard, or "strong," form, natural selection operates at the population level only – on the entire organism-environment whole of replicable DS. The organism cannot be separated from the environment, making adaptation by natural selection at the level of the organism impossible. In contrast, the soft, or "weak," form of DS theory adopts mainstream biology's distinction between the organism and the environment, treating organisms and their environments as separable. The whole organism is the focus

of selection pressures, thus making an adaptationist approach viable. This does not mean that organisms are independent of their environments. They clearly are not, yet, for theoretical purposes, they can be treated as distinct aspects in evolutionary models.

EDP approaches adopt an explicitly soft version of DS theory [e.g., Bjorklund, 2015; Bjorklund & Ellis, 2014; Bjorklund, Hernández Blasi, & Ellis, 2016; Del Giudice & Ellis, 2016]. They adhere to a neo-Darwinian adaptationist perspective, providing a developmental theory (soft DS) that can be integrated with evolutionary theory to provide a metatheory for developmental psychology. EDP theorists propose that infants are not born as blank slates but enter the world with, or develop early, behavioral, perceptual, and cognitive biases or constraints that affect how they process information. Geary [1995, 2005] has referred to these as *skeletal competencies,* which are fleshed out in development mainly through play. In other words, infants and children are prepared by natural selection to selectively process some information in the evolutionarily relevant domains of folk psychology, folk biology, and folk physics. But *prepared is not preformed* [Bjorklund, 2003]. Rather, patterns of behavior and cognition emerge via the interaction of these low-level competencies and environment to produce (usually) adaptive behavior. My colleagues and I proposed the concept of *evolved probabilistic cognitive mechanisms* [Bjorklund, 2015; Bjorklund & Ellis, 2014; Bjorklund, Ellis, & Rosenberg, 2007] to describe this process.

Cognitive Mechanisms in Evolutionary Explication

A central tenet of mainstream evolutionary psychology is that what evolved are information-processing mechanisms (*evolved cognitive mechanisms*). Such mechanisms are the "missing link" in evolutionary explication. Evolved cognitive mechanisms have been shaped by natural selection to solve recurrent problems faced by our ancestors associated with survival and reproduction [Buss, Haselton, Shackelford, Bleske, & Wakefield, 1998; Pinker, 1997; Tooby & Cosmides, 1992, 2005]. Yet, a missing component in evolutionary psychology's concept of evolved cognitive mechanism is development, which evolved probabilistic cognitive mechanisms address. Bjorklund et al. [2007] defined evolved probabilistic cognitive mechanisms as

> information-processing mechanisms that have evolved to solve recurrent problems faced by ancestral populations; however, they are expressed in a probabilistic fashion in each individual in a generation, based on the continuous and bidirectional interaction over time at all levels of organization, from the genetic through the cultural. These mechanisms are universal, in that they will develop in a species-typical manner when an individual experiences a species-typical environment over the course of ontogeny [Bjorklund et al., 2007, p. 22].

Witherington and Lickliter examined an example of face-processing in infants provided by Bjorklund [2015] to illustrate an evolved probabilistic cognitive mechanism, and state that the

> example establishes a perfectly reasonable emergence account for the development of these mechanisms. But the more his developmental account of face processing aligns with a DS approach, the more superfluous the notion of evolved mechanisms becomes. If this evolved mechanism is nothing more than an emergent product of developmental processes, how is it any different from every other new level of functioning and organization that emerges

> over the course of development? … If these initial processing biases are genetically "prepared" biases, built into the organism by natural selection, then Bjorklund's account ignores the developmental activities that must necessarily take place to construct the biases themselves, since such organismic biases – like the evolved mechanisms that derive from them – are irreducible to the local activities of genes and other molecular developmental resources [pp. 23, 24].

Of course, the low-level face-processing biases and constraints of young infants can trace their origins back to prenatal development and bidirectional interactions between sensory stimulation, neurons, neurotransmitters, proteins, RNA, and DNA, all changing over time; but it is not always necessary for psychologists to delve into prenatal history to describe and explain important postnatal behavior. No one is arguing that what happens before birth can have important developmental consequences. For example, prenatal experiences can affect subsequent levels of cortisol and health [e.g., Flinn, 2006], caloric metabolism [e.g., Gluckman & Hanson, 2005], gustatory preferences [e.g., Schaal, Marlier, & Soussignan, 2000], and attachment patterns [e.g., Gottlieb, 1991], often in adaptive ways. Gluckman and Hanson [2005] refer to such adaptive changes in fetuses' developmental trajectory as *predictive adaptive responses*. Yet, although one should always be mindful that experience and development precede birth, proposing mechanisms to describe developmental changes based solely on postnatal behavior provides a useful level of analysis, one that Witherington and Lickliter seem to find objectionable.

In many areas of psychology, scientists admit to not knowing all there is to know about how a phenomenon functions but develop psychological concepts such as "representations" or "cognitive mechanisms" to facilitate an understanding of the behavior/cognition under question. Such concepts permit one to look for similar mechanisms for similar phenomena, to explain behavior/cognition using a common language, to generate and test new hypotheses, and to make predictions. Having such concepts does not preclude learning more about the development of the phenomenon under question, but it does permit scientists to think about phenomena in productive ways.

Psychological mechanisms represent a level of analysis central to theorizing in modern psychology, and this is a level that Witherington and Lickliter would seemingly be glad to see eliminated, making their perspective an outlier in contemporary psychological science. In contrast, I argue that the concept of evolved probabilistic cognitive mechanisms is not superfluous, but a useful concept that potentially advances understanding of important developmental phenomena.

However, evolved cognitive mechanisms are, admittedly, hypothetical constructs. They, as well as concepts such as adaptations, personality, and concrete operations, for example, are derived to help scientists obtain a clearer picture of a phenomenon. I believe that Witherington and Lickliter are correct in stating that psychologists too easily reify such hypothetical constructs, including those central to evolutionary psychological explication such as adaptations and evolved cognitive mechanisms. Thinking of adaptations, for example, as they are conventionally defined by evolutionary psychology causes us to view them as something concrete and "real," which is sensible enough, I suppose, for an evolutionist. But viewing adaptations as coherent, organized, and stable entities may prevent closer examination of their origins and, importantly, their development. This, of course, is also true for evolved probabilistic cognitive mechanisms, but one of the purposes of proposing

such a concept was to demonstrate that adaptive behavior emerges from earlier-developing, lower-level processes in interaction with one's environment. Unlike Witherington and Lickliter, I argue that such mechanisms are scientifically useful, despite admittedly being hypothetical constructs.

Conclusion

Witherington and Lickliter's critique of EDP is scholarly, detailed, generally accurate, and timely. It is a good read. However, rather than discrediting EDP as a well-meaning but failed attempt at integrating evolution and development, I view their impressive paper as the presentation of two alternate views of how development and evolution can be integrated following DS theories. Following the hard version of DS theory, as represented by Overton's approach, natural selection cannot be applied to the individual but only to the population, and formal and final forms of causation are implicated. Following the soft version of DS theory as advocated by proponents of EDP, natural selection operates on the individual, taking an explicitly adaptationist perspective. Witherington and Lickliter accuse EDP of assimilating DS into a "decidedly selectional explanatory perspective" (p. 6). To this I, and I suspect most other advocates of EDP, plead guilty. Such an approach is admittedly at odds with a hard version of DS. However, it is not incompatible with soft DS, but rather reflects a theoretically defensible and useful way of integrating evolution and development.

One criticism of DS approaches has been that, although they provide a powerful and useful framework for thinking about development, they are too global to be translated into a research program [Buss & Reeve, 2003; Robert et al., 2001]. I believe this remains true of Witherington and Lickliter's current proposal. I was looking for applications of their revolutionary development-evolution theory to issues of child development but found none. DS theory provides an important perspective of development, but, I believe, the theory has its greatest scientific impact when joined with other explanatory theories, such as those proposed by evolutionary psychology.

As Witherington and Lickliter noted, evolutionary perspectives of development have become increasingly popular in the scientific literature. This can be seen in research and theorizing in social-cognitive development [e.g., Tomasello, 2016], brain development [e.g., Giedd, 2012], tool use [e.g., Bjorklund & Gardiner, 2011], development of emotions [LoBue & DeLoache, 2010], object representation [e.g., Spelke & Kinzler, 2007], sex differences [e.g., Geary, 2010], and research into the role of early experience on later development [e.g., Ellis et al., 2012], among others. Rather than reflecting a misrepresentation of true DS theory, EDP is a coherent, integrative discipline that is on its way to providing for developmental psychology a metatheory – a common set of broad, overarching assumptions and principles – that, if adopted, can unite and guide research in developmental psychology and better integrate developmental psychology with the life sciences [Bjorklund, 1997; Ploeger, van der Maas, & Raijmakers, 2008].

Acknowledgments

I would like to thank Kayla Causey and Carlos Hernández Blasi for helpful comments on earlier drafts of this paper.

References

Bjorklund, D.F. (1997). In search of a metatheory for cognitive development (or, Piaget is dead and I don't feel so good myself). *Child Development, 68*, 142–146. doi:10.2307/1131932

Bjorklund, D.F. (2003). Evolutionary psychology from a developmental systems perspective: Comment on Lickliter and Honeycutt (2003). *Psychological Bulletin*, *129*, 836–841. doi:10.1037/0033-2909.129.6.836

Bjorklund, D.F. (2015). Developing adaptations. *Developmental Review, 38,* 13–35. doi:10.1016/j.dr.2015.07.002

Bjorklund, D.F., & Ellis, B.J. (2014). Children, childhood, and development in evolutionary perspective. *Developmental Review, 34,* 225–264. doi:10.1016/j.dr.2014.05.005

Bjorklund, D.F., Hernández Blasi, C., & Ellis, B.J. (2016). Evolutionary developmental psychology. In D.M. Buss (Ed.), *Evolutionary psychology handbook*, 2nd ed. *Vol. 2* (pp. 904–925). New York, NY: Wiley.

Bjorklund, D.F., Ellis, B.J., & Rosenberg, J.S. (2007). Evolved probabilistic cognitive mechanisms: An evolutionary approach to gene × environment × development interactions. In R.V. Kail (Ed.), *Advances in child development and behavior. Vol. 35* (pp. 1–39). Oxford: Elsevier. doi:10.1016/B978-0-12-009735-7.50006-2

Bjorklund, D.F., & Gardiner, A.K. (2011). Object play and tool use: Developmental and evolutionary perspectives. In A.D. Pellegrini (Ed.), *Oxford handbook of play* (pp. 153–171). Oxford: Oxford University Press.

Buss, D.M., Haselton, M.G., Shackelford, T.K., Bleske, A.L., & Wakefield, J.C. (1998). Adaptations, exaptations, and spandrels. *American Psychologist*, *53*, 533–548. doi:10.1037/0003-066X.53.5.533

Buss, D.M., & Reeve, H.K. (2003). Evolutionary psychology and developmental dynamics: Comment on Lickliter and Honeycutt (2003). *Psychological Bulletin*, *129*, 848–853. doi:10.1037/0033-2909.129.6.848

Dawkins, R. (1976). *The selfish gene*. New York, NY: Oxford University Press.

Del Giudice, M., & Ellis, E.J. (2016). Evolutionary foundations of developmental psychopathology. In D. Cicchetti (Ed.), *Developmental psychopathology,* 3rd ed. *Vol. 2: Developmental neuroscience* (pp. 1–58). New York, NY: Wiley. doi:10.1002/9781119125556.devpsy201

Ellis, B.J., Del Giudice, M., Dishion, T.J., Figueredo, A.J., Gray, P., Griskevicius, V., Hawley, P.H., & Wilson, D.S. (2012). The evolutionary basis of risky adolescent behavior: Implications for science, policy, and practice. *Developmental Psychology, 48*, 598–623. doi:10.1037/a0026220

Flinn, M.V. (2006). Evolution and ontogeny of stress response to social change in the human child. *Child Development, 26*, 138–174.

Frankenhuis, W.E., Panchanathan, K., & Barrett, H.C. (2013). Bridging developmental systems theory and evolutionary psychology using dynamic optimization. *Developmental Science*, *16*, 584–598. doi:10.1111/desc.12053

Geary, D.C. (1995). Reflections of evolution and culture in children's cognition: Implications for mathematical development and instruction. *American Psychologist, 50,* 24–37. doi:10.1037/0003-066X.50.1.24

Geary, D.C. (2005). *The origin of mind: Evolution of brain, cognition, and general intelligence*. Washington, DC: American Psychological Association. doi:10.1037/10871-000

Geary, D.C. (2010). *Male, female: The evolution of human sex differences,* 2nd ed. Washington, DC: American Psychological Association. doi:10.1037/12072-000

Giedd, J.N. (2012). The digital revolution and adolescent brain development. *Journal of Adolescent Health, 51*, 101–105. doi:10.1016/j.jadohealth.2012.06.002

Gluckman, P., & Hanson, M. (2005). *The fetal matrix: Evolution, development, and disease*. Cambridge: Cambridge University Press.

Gottlieb, G. (1987). The developmental basis of evolutionary change. *Journal of Comparative Psychology, 101*, 262–271. doi:10.1037/0735-7036.101.3.262

Gottlieb, G. (1991). Experiential canalization of behavioral development: Results. *Developmental Psychology*, *27*, 35–39. doi:10.1037/0012-1649.27.1.35

Gottlieb, G. (1992). *Individual development and evolution: The genesis of novel behavior*. New York, NY: Oxford University Press.

Gottlieb, G. (2007). Probabilistic epigenesis. *Developmental Science, 10*, 1–11. doi:10.1111/j.1467-7687.2007.00556.x

Griffiths, P.E. (1996). Darwinism, process structuralism, and natural kinds. *Philosophy of Science, 63* (Proceedings), S1–S9. doi:10.1086/289930

Griffiths, P.E., & Gray, R.D. (1994). Developmental systems and evolutionary explanation. *Journal of Philosophy, 91*, 277–304. doi:10.2307/2940982

Griffiths, P.E., & Gray, R.D. (2005). Discussion: Three ways to misunderstand developmental systems theory. *Biology and Philosophy, 20*, 417–425. doi:10.1007/s10539-004-0758-1
Kuo, Z.Y. (1967). *The dynamics of behavior development: An epigenetic view*. New York, NY: Random House.
Lehrman, D.S. (1970). Semantic and conceptual issues in the nature-nurture problem. In L.R. Aronson, D.S. Lehrman, E. Tobach, & J.S. Rosenblatt (Eds.), *Development and evolution of behavior* (pp. 17–52). San Francisco, CA: Freeman.
LoBue, V., & DeLoache, J.S. (2010). Superior detection of threat-relevant stimuli in infancy. *Developmental Science*, *13*, 221–228. doi:10.1111/j.1467-7687.2009.00872.x
Overton, W.F. (2015). Processes, relations, and relational-developmental-systems. In W.F. Overton & P.C.M. Molenaar (Vol. Eds.), & R.M. Lerner (Ed.-in-Chief), *Handbook of child psychology and developmental science,* 7th ed. *Vol. 1: Theory and method* (pp. 9–62). Hoboken, NJ: Wiley. doi:10.1002/9781118963418.childpsy102
Overton, W.F., & Lerner, R.M. (2012). Relational developmental systems: A paradigm for developmental science in the postgenomic era. *Behavioral and Brain Sciences, 35,* 375–376. doi:10.1017/S0140525X12001082
Oyama, S. (1985). *The ontogeny of information: Developmental systems and evolution*. New York, NY: Cambridge University Press.
Oyama, S. (2000). *Evolution's eye: A systems view of biology-culture divide*. Durham, NC: Duke University Press. doi:10.1215/9780822380658
Oyama, S. (2009). Friends, neighbors, and boundaries. *Ecological Psychology, 21*, 147–154. doi:10.1080/10407410902877173
Pinker, S. (1997). *How the mind works*. New York, NY: Norton.
Ploeger, A., van der Maas, H.L.J., & Raijmakers, M.E.J. (2008). Is evolutionary psychology a metatheory for psychology? A discussion of four major issues in psychology from an evolutionary developmental perspective. *Psychological Inquiry*, *19*, 1–18. doi:10.1080/10478400701774006
Pradeu, T. (2010). The organism in developmental systems theory. *Biological Theory, 5*, 216–222. doi:10.1162/BIOT_a_00042
Robert, J.S., Hall, B.K., & Olson, W.M. (2001). Bridging the gap between developmental systems theory and evolutionary developmental biology. *Bioessays, 23*, 954–962. doi:10.1002/bies.1136
Schaal, B., Marlier, L., & Soussignan, R. (2000). Human foetuses learn odours from their pregnant mother's diet. *Chemical Senses*, *25*, 729–737. doi:10.1093/chemse/25.6.729
Schneirla, T.C. (1957). The concept of development in comparative psychology. In D.B. Harris (Ed.), *The concept of development: An issue in the study of human behavior* (pp. 78–108). Minneapolis, MN: University of Minnesota Press.
Spelke, E.S., & Kinzler, K.D. (2007). Core knowledge. *Developmental Science, 10*, 89–96. doi:10.1111/j.1467-7687.2007.00569.x
Tomasello, M. (2016). Cultural learning redux. *Child Development, 87*, 643–653. doi:10.1111/cdev.12499
Tooby, J., & Cosmides, L. (1992). The psychological foundations of culture. In L. Cosmides, J. Tooby, & J.H. Barkow (Eds.), *The adapted mind* (pp. 19–136). New York, NY: Oxford University Press.
Tooby, J., & Cosmides, L. (2005). Conceptual foundations of evolutionary psychology. In D.M. Buss (Ed.), *Handbook of evolutionary psychology* (pp. 5–67). New York, NY: Wiley.