

Evolutionary Psychology as a Metatheory for the Social Sciences

Annemie Ploeger¹

Abstract: Evolutionary psychology has been proposed as a metatheory for the social sciences. In this paper, the different ways in which scholars have used the concept of a metatheory in the field of evolutionary psychology is reviewed. These different ways include evolutionary psychology as a unification of different subdisciplines, as a nomological network of evidence, as Lakatosian hard core, as a tool for conceptual integration, and as a theory that addresses the major issues in the social sciences. It is concluded that evolutionary psychology has been successful as Lakatosian hard core, that is, it has been fruitful in generating new hypotheses. However, it has been less successful in unifying different subdisciplines. It is also concluded that evolutionary psychology needs to broaden its scope by including insights from evolutionary developmental biology in order to become a unifying framework for the social sciences.

Keywords: Evolutionary developmental biology, evolutionary psychology, metatheory.

Introduction

Evolutionary psychology is psychology that is informed by theory and research of evolutionary biology, with the idea that knowledge about the evolutionary background of psychological phenomena will contribute to the understanding of these phenomena (Cosmides, Tooby, & Barkow, 1992). The main tenet of evolutionary psychology is that the mind consists of a set of information-processing mechanisms, which have evolved by natural selection. These mechanisms are adaptations that are functionally specialized to deal with problems in particular circumstances, and therefore must be content-specific and richly structured (Tooby & Cosmides, 1992).

It has been argued that evolutionary psychology may provide a metatheory for psychology and the other social sciences (Buss, 1995; Cosmides, Tooby, & Barkow, 1992). Evolutionary psychology is considered to be an overarching theory whose principles can be applied to all fields in the social sciences (Duntley & Buss, 2008). In the present article, I review the different ways in which researchers have used the concept of a metatheory in the field of evolutionary psychology. In addition, I evaluate whether these attempts have resulted in the desired metatheory for the social sciences.

¹ **Annemie Ploeger** (1973) received her PhD degree at the University of Amsterdam in 2008. Chapters of her thesis *Towards an Integration of Evolutionary Psychology and Developmental Science: New Insights from Evolutionary Developmental Biology*, were published in *Psychological Inquiry*, *Psychiatry Research*, and *Biological Psychiatry*. After being a visiting scholar at the University of California, Los Angeles, she now works as an assistant professor in Developmental Psychology at the University of Amsterdam.

a.ploeger@uva.nl



Different Ways to Use Evolutionary Psychology as a Metatheory

Several authors have contributed to the discussion on the metatheoretical status of evolutionary psychology. In this section I give an overview of these contributions, and I discuss whether these contributions are useful in achieving the desired metatheory for the social sciences.

Evolutionary Psychology Can Unify Different Subdisciplines in Psychology

Buss (1995) argued that evolutionary psychology could be a metatheory for psychology. Psychology is currently in conceptual disarray, with each branch, such as social, developmental, or organizational psychology, working on its own mini-theories. There is no overarching theory that integrates or unites the empirical findings in the different subdisciplines. Behaviorism used to be a metatheory for psychology, but explaining human behavior and cognition only by stimulus-response relationships appeared to be a too simple picture of how the mind works (e.g., Seligman, 1970). In response to behaviorism, cognitivism arose and claimed that the human mind consisted of information-processing mechanisms that could be compared to the working of a computer. But also the mind-as-a-computer appeared to be an oversimplified metaphor (e.g., Searle, 1990). Evolutionary psychology may fill the remaining hole by offering the process of natural selection that applies to any part of nature, as a unifying construct in social science.

The metatheory of evolutionary psychology that Buss (1995) proposed, consists of a hierarchy of levels of analysis. At the top of the hierarchy is general evolutionary theory, as represented by inclusive fitness theory (Hamilton, 1964). Inclusive fitness refers to the fitness of a genotype measured not only by its effects on an individual who possesses the genotype, but also by its effects on genetically related individuals. Inclusive fitness theory predicts that organisms behave to maximize their inclusive fitness. Evolutionary psychologists assume that this general theory is correct, and do not test this general theory directly. However, this does not imply that this general theory remains untested. Inclusive fitness theory has been tested by thousands of evolutionary biologists, in field experiments, lab experiments, and with computer simulations; thousands of tests have confirmed inclusive fitness theory, so this theory is broadly accepted by scientists (Buss, 1995).

Evolutionary psychologists do test theories that are derived from inclusive fitness theory, such as the theory of reciprocal altruism (Trivers, 1971) and the theory of parental investment (Trivers, 1972). Buss (1995) referred to these theories as middle-level evolutionary theories. From these middle-level theories, specific hypotheses and predictions can be derived. These predictions can be tested by "normal" scientific procedures, such as experiments, questionnaire methods and psychophysiological techniques.

Buss (1995) outlined what evolutionary psychology can contribute to research questions on social, personality, developmental, and cognitive psychology. For example, evolutionary psychology may be a fruitful approach for social psychologists that work on the issue of alliance formation and friendships. Based on reciprocal altruism theory, it is predicted that humans will form alliances and friendships with unrelated individuals, but only if the costs are less than or equal to the benefits. In a recent paper, Duntley and Buss (2008) go even further and argued that:

evolutionary psychology also unites the field of psychology with all the other life sciences, including biology, economics, political science, history, legal scholarship, and medicine; it unites humans with all other species, revealing our place in the grand scheme of the natural world. (p. 31)

According to evolutionary psychologists, the key research issue that all psychologists (and social scientists in general) should address is the identification of adaptive problems that humans had to deal with repeatedly over our evolutionary history, in order to learn what the mechanisms of the mind are "designed" to do. This claim is in accordance with Daniel Dennett's (1995) *Darwin's Dangerous Idea*, the idea that natural selection is the central process in any complex form alive on earth. Because human behavior and cognition can be considered to be complex, the origin of most human behavior and cognition can be explained by referring to natural selection, including social behavior, community behavior, personality, and psychological disorders.

Today, fifteen years after the publication of Buss' (1995) proposal, how far are we away from a bridge between the different subdisciplines in psychology? Evolutionary psychology as a new approach has been successful, with hundreds of new discoveries that had eluded other psychologists (e.g., Buss & Reeve, 2003). For example, the work of Daly and Wilson (1985) on stepparenthood and the increased risk of child abuse is inspired by and congruent with inclusive fitness theory. However, being empirically successful is not the same as providing a unification of different subdisciplines. In the last fifteen years, evolutionary psychology appeared to develop into a successful approach, but more or less separately from the other subdisciplines. It has become a subdiscipline by itself. Why did it turn out that evolutionary psychology has not been embraced as the metatheory that unites all subdisciplines in psychology?

One major reason is that evolutionary psychology has met with substantial criticism (e.g., Davies, 1996; Fodor, 2000; Lewontin, 1998; Looren de Jong & van der Steen, 1998; Richardson, 1996). For example, Lewontin (1998) argued that we will *never* know how our cognition evolved, because it is impossible to collect the necessary evidence. Cognition does not fossilize, and our ancestors (e.g., *Homo habilis*, *Homo erectus*) are extinct so we have no recent sister species with which we can compare our cognition. According to Lewontin, these kinds of evidence are necessary to decide whether a given psychological mechanism is an adaptation or not. If it is not possible to collect the necessary evidence, then the whole enterprise of evolutionary psychology will be a failure, and the desired metatheory is still far away. In response to these criticisms, different approaches to evolutionary psychology as a metatheory have been formulated. One is evolutionary psychology as a nomological network of evidence.

Evolutionary Psychology as a Nomological Network of Evidence

According to evolutionary psychologists, it is not impossible to provide empirical evidence for the existence of evolved psychological mechanisms. One way to solve this problem is creating a nomological network of evidence (Schmitt & Pilcher, 2004). Evolutionary psychologists collect data from a wide variety of sources, which together provide evidence for the putative adaptation. In order to conclude that a psychological mechanism has evolved by natural selection, Schmitt and Pilcher recommend collecting data from eight different sources. First of all, there has to be a theory, grounded in evolutionary biology, cost-benefit analyses,

and/or computer simulations. The next step is to provide psychological evidence, with methods accepted by psychologists, such as experiments or surveys. In addition, one needs medical evidence, for example from fertility and fecundity studies. Next, physiological evidence is required, for example from neurobiological research. Genetic evidence can be collected by means of behavioral or molecular genetics studies. Phylogenetic evidence can be found by means of comparative or paleontological methods. Hunter-gatherer data can be collected with cultural anthropological research. In addition, cross-cultural evidence can be gathered with ethnological comparisons or with a search for human universals. By collecting data from several sources, a nomological network can support evolutionary hypotheses about the human mind.

For example, Schmitt and colleagues (2003) have argued that there is a sex difference in desire for sexual variety, and that this sex difference is an adaptation. In general, men tend to long for more sexual short-term relationships than women. This hypothesis is derived from parental-investment theory, which is grounded in evolutionary biology. Schmitt and colleagues gathered data from 52 nations on 6 different continents and provided cross-cultural evidence for this hypothesis. There is also ample psychological evidence (based on surveys, behavioral experiments, etc.); comparative studies have shown the same tendency in nonhuman species (i.e., phylogenetic evidence), and physiological studies have indicated that testosterone and morphological characteristics play a role in the manifestation of this adaptation. Many pieces of evidence have been collected so far, although some components of a full evolutionary explanation are missing, but future studies may fill this gap.

This example shows that it is possible to provide evidence for an evolutionary hypothesis, but it also shows that an ambitious research program is necessary in order to create a satisfying nomological network. However, the question remains whether nomological networks of evidence for certain individual hypotheses provide a metatheory for psychology. A nomological network of evidence can provide support for the existence of a psychological adaptation, and this shows that the framework of evolutionary psychology has scientific value. However, such a nomological network of evidence does not show that all other researchers in the social sciences should use evolutionary psychology as their metatheory. A related proposal about evolutionary psychology as a metatheory, based on Lakatosian philosophy of science, may provide insight in this issue.

Evolutionary Psychology as Lakatosian Hard Core

It has been argued that evolutionary psychology can be a metatheory by providing a set of consensually held assumptions that lead to the generation of new theories and hypotheses (Ketelaar & Ellis, 2000). Philosopher of science Lakatos (1970) called these assumptions the hard core of a metatheoretical research program. The hard core operates like a map - it shows which roads to take and which roads to avoid; it provides heuristics, which narrow the scope of research to a set of plausible a priori hypotheses. The hard core of evolutionary psychology is represented by Hamilton's (1964) inclusive fitness theory, which is assumed to be true. This assumption is not just a belief - it is grounded in the myriad of empirical findings that evolutionary biologists gathered in favor of inclusive fitness theory. The auxiliary hypotheses - the protective belt, in Lakatosian terms - are subject to empirical testing. Metatheories are evaluated by the performance of the protective belt. If the metatheory generates new hypotheses

and explanations, then the metatheory is judged to be progressive; if not it is judged to be degenerative.

As was argued before, evolutionary psychology has been a fruitful empirical approach, with many new discoveries and explanations (Buss & Reeve, 2003). In this sense it has been a progressive metatheory. So if we adopt a Lakatosian view of a metatheory, evolutionary psychology is evaluated as a fruitful metatheory. However, it is still problematic that evolutionary psychology so far is more a subdiscipline on its own, rather than an integrative, overarching theory for the social sciences. This leads to the following intriguing suggestion: the generation of novel hypotheses may lead to the creation of more areas of investigation, which results in the development of more subfields and eventually to an increasing fragmentation of the science, rather than a unification of different fields. Although it is hard to prove this idea, it may lead to the conclusion that a hard core theory that generates many novel hypotheses is not necessarily a metatheory that should be used by all social scientists. A good metatheory is a framework that all social scientists use to evaluate their theories. There are two approaches to evolutionary psychology as a metatheory that have not been described yet, which may offer a way out of the isolation of evolutionary psychology from other scientific disciplines.

Evolutionary Psychology Provides Conceptual Integration

It has been suggested that evolutionary psychology may be a metatheory for psychology by providing *conceptual integration*, or *vertical integration*, that is, the principle that all scientific disciplines should be mutually consistent (Cosmides, Tooby, & Barkow, 1992). In the natural sciences, different disciplines are already mutually consistent, for example, the laws of chemistry are compatible with the laws of physics. Cosmides and colleagues argued that in the social sciences compatibility is lacking, leading to theories that contradict each other and leading to theories that may not be feasible from an evolutionary point of view. Conceptual integration may lead to the solution of problems in one's own discipline by adopting methods and knowledge from other disciplines:

Evidence from evolutionary biology can help social psychologists generate new hypotheses about the design features of the information-processing mechanisms that govern social behavior; evidence about cognitive adaptations can tell evolutionary biologists something about the selection pressures that were present during hominid evolution; evidence from paleoanthropology and hunter-gatherer studies can tell developmental psychologists what kind of environment our developmental mechanisms were designed to operate in; and so on. (Cosmides, Tooby, & Barkow, 1992, p. 12)

The proposal that evolutionary psychology can provide conceptual integration has been challenged by Looren de Jong and van der Steen (1998). They argued that evolutionary biology does not provide any laws, such as laws in physics or chemistry. Concepts such as adaptation and fitness are not fixed entities covering general patterns of evolution. Whether one calls a trait an adaptation depends on the criteria that one sets for an adaptation. These criteria are still highly debated in evolutionary biology (e.g., Brandon, 1990). Looren de Jong and van der Steen argued that evolutionary biology is not united at all, and it does not provide causal laws of hard science, so it cannot bring conceptual integration.

Lickliter and Honeycutt (2003) argued that psychology could be conceptually integrated with evolutionary biology, but that conceptual integration failed because evolutionary psychology so far has focused too much on inclusive fitness theory, a gene-centered theory. It would be more fruitful for psychology to focus on developmental systems theory. Developmental systems theorists do not view the gene as the center of evolution, but the whole developmental system at all its levels: molecular, cellular, physiological behavioral and environmental (see also Gottlieb, 2000). A true evolutionary metatheory for the social sciences should not only include inclusive fitness theory, but also an integration of the fields of genetics, embryology and developmental biology.

So far we can draw three conclusions with regard to the metatheoretical status of evolutionary psychology, one positive and two negative. The positive conclusion is that evolutionary psychology has been fruitful as a Lakatosian metatheory that generates new discoveries and explanations. A negative conclusion is that this metatheory has not resulted in a unification or conceptual integration of different scientific areas. This may be a natural consequence of having a successful theory that leads to the generation of novel hypotheses, which in turn leads to new fields of investigation, rather than an integration of fields. Another possibility is that the absence of unification is the result of the scope of the metatheory of evolutionary psychology. The scope of evolutionary psychology is inclusive fitness theory, and this scope may be too narrow to function as a metatheory for the social sciences. So the third conclusion is that if evolutionary psychology is the desired metatheory for the social sciences, then it may be necessary to broaden its scope in order to reach unification of different fields. These preliminary conclusions lead to a last approach to evolutionary psychology as a metatheory: evolutionary psychology is a metatheory for the social sciences if it cannot only generate new hypothesis, but it should also be able to address the main theories, or metaissues in the field, for example, the nature-nurture debate.

Evolutionary Psychology as a Metatheory that Addresses the Major Issues in the Social Sciences

Another approach to evolutionary psychology as a metatheory is that it should contribute to the major issues in the field (Ploeger, van der Maas, & Raijmakers, 2008). With regard to psychology, the major issues can be formulated as:

- Is the human mind mostly modular, or is the mind domain-general?
- What is the influence of nature and nurture on the human mind?
- Does development proceed in stages or gradually?
- How do individual differences arise?

My colleagues and I have argued that the contribution of the current metatheory of evolutionary psychology, that is, inclusive fitness theory, to these major question is too limited. With regard to the first question, evolutionary psychologists have argued that the mind is most likely to be modular, because modularity is a more efficient way to solve problems than a domain-general problem-solver (e.g., Cosmides & Tooby, 1994). However, this argument leaves unexplained the existence of several domain-general abilities (for an overview, see Ploeger et al., 2008).

With respect to the nature-nurture debate, evolutionary psychologists have explained why it is likely that the mind consists of many evolved psychological mechanisms, but they have so far not developed models that can account for the interaction or transaction between the genome and the environment. Evolutionary psychologists have not discussed the question whether development proceeds in stages or gradually, and from inclusive fitness theory alone it is not straightforward how the present metatheory of evolutionary psychology can contribute to this issue. With regard to the question about individual differences, evolutionary psychology so far has focused on discovering human universals, leaving the question about individual differences unanswered (e.g., Tooby & Cosmides, 1990), although there have been some evolutionary psychologists who have tried to address this issue (e.g., Buss, 2009; Wilson, 1994).

My colleagues and I have argued that evolutionary psychology should broaden its scope in order to become a fruitful metatheory that can address all the basic issues (Ploeger et al., 2008). We argued that theories and empirical findings from evolutionary developmental biology should be included in the metatheory, and we showed that this inclusion leads to new insights that contribute to the major debates in psychology. Evolutionary developmental biology is an approach that forges a synthesis of processes operating during individual development with those operating between generations (Carroll, 2005; Hall & Olson, 2003). This approach has led to a wealth of theories and empirical findings that are highly relevant to psychology, but have yet to be integrated. For example, with regard to the question whether the human mind is modular, there has been a lively debate among evolutionary developmental biologists about the role of modularity in evolution. Recent findings have shown that under some specific conditions modularity is more likely to evolve, while under other conditions there will be less modularity (Griswold, 2006). These findings can be used to explain the co-existence of modular and more domain-general structures in the human mind.

With respect to the nature-nurture debate, models that include both genetic and environmental factors have been studied extensively in the field of evolutionary developmental biology. These models can result in new insights for psychology, for example that there must exist a third source of variance, besides genes and environment, that consists of self-organized processes (Molenaar, Boomsma & Dolan, 1993). Research has shown that there is still considerable variation in body weight of mice, although their genetic makeup and their food intake are kept constant (Gaertner, 1990). This points in the direction of a third source of variance, for which models in evolutionary developmental biology provide an explanation (e.g., Kauffman, 1993). In addition, there has been ample research from an evolutionary developmental perspective on stages or phase transitions and their importance for development and evolution (e.g., Stadler, Stadler, Wagner, & Fontana, 2001). Also research on individual differences is abundant in evolutionary developmental biology (e.g., Zhang & Hill, 2005).

Thus, by broadening the scope of evolutionary psychology, it is possible to give a unique view on the major issues in psychology, by integrating psychology and insights from evolutionary developmental biology.

Discussion

It has been argued that evolutionary psychology could be a metatheory for the social sciences (e.g., Buss, 1995). In this paper, an overview of different arguments has been given, and the value of these arguments has been evaluated. Buss (1995) argued that evolutionary psychology could unify the different subdisciplines of psychology that so far have worked in isolation. The metatheory that could establish this unification was inclusive fitness theory (Hamilton, 1964). However, so far evolutionary psychologists have not been able to bridge the gap between different research areas.

First of all, it could be argued that we should not desire to build a metatheory that connects all areas in psychology and the social sciences. It may be impossible to have such an overarching theory, because the different areas in psychology and the social sciences are too specialized and address too many different questions. In addition, mini-theories and individual empirical findings have their own merit, and should not be disregarded.

Second, if we believe that a metatheory is desirable, it could be argued that unification of different disciplines should not be the main aim of a metatheory. Instead, it could be argued that the main aim of a metatheory is to evaluate different theories within a field. For evolutionary psychology, this would imply that its framework can be used to evaluate theories such as Skinner's learning theory, Piaget's developmental theory and Festinger's theory of cognitive dissonance. These theories should be consistent with the principles of evolutionary theory. This idea is closely related to the proposal of Cosmides, Tooby and Barkow (1992), who have argued that evolutionary psychology can provide conceptual integration, that is, it can make the social sciences more consistent with each other and the natural sciences. However, a problem with this view is that evolutionary biology does not provide laws, like physics and chemistry do, and that it is not clear whether evolutionary biology is united itself, so it cannot provide conceptual integration (Looren de Jong & van der Steen, 1998).

Evolutionary psychology has met other criticisms. For example, it has been argued that evolutionary psychologists cannot provide empirical evidence for the theory that the mind consists of many evolved psychological mechanisms, or adaptations (Lewontin, 1998). However, it is possible to provide this evidence by means of nomological networks of evidence (Schmitt & Pilcher, 2004). But this may lead to the argument that a nomological network of evidence does not provide a metatheory, but that such a network can be used to evaluate hypotheses that are related to the metatheory. In terms of Lakatosian philosophy of science, the nomological network of evidence is the protective belt of the metatheory, not the metatheory itself.

It has been proposed that evolutionary psychology should be perceived from the perspective of Lakatosian philosophy of science (Ketelaar & Ellis, 2000). A metatheory from this perspective is defined as a set of consensually held assumptions that lead to the generation of new theories and hypotheses. For evolutionary psychology, these consensually held assumptions are the basic tenets of evolutionary theory, or more specifically, inclusive fitness theory. Because inclusive fitness theory has been confirmed thousands of times by evolutionary biologists, it can be assumed that this theory is correct. Evolutionary psychology has been a fruitful approach to generating new hypotheses (Buss & Reeve, 2003), so in the Lakatosian sense, evolutionary

psychology is a true metatheory. The hard core, that is, inclusive fitness theory, is protected by the protective belt of confirmed hypotheses. However, the hard core of evolutionary psychology has not led to the unification of different fields. It may be that the generation of novel hypotheses leads to the creation of more different areas of investigation, and thus to more fragmentation, instead of unification.

A last approach to evolutionary psychology as a metatheory is based on the idea that a metatheory should contribute to the major issues in a field. Ploeger, van der Maas and Raijmakers (2008) have argued that inclusive fitness theory alone cannot provide a satisfying contribution to the major issues in psychology, but that evolutionary psychology needs to broaden its scope. Possibilities are the inclusion of dynamical systems theory (e.g., Kenrick, 2001), evolutionary game theory (Nowak, 2006), evolutionary cognitive neuroscience (e.g., Platek, Keenan, & Shackelford, 2007), and evolutionary developmental biology (e.g., Ploeger et al., 2008). We have focused on the last approach, and we have shown that if evolutionary psychology is willing to include theories and empirical findings from evolutionary developmental biology, it can give a unique view on the major issues. If evolutionary psychology can give answers to the questions that have occupied the minds of psychologists for so long, it may truly become a unifying framework for the social sciences.

References

- Brandon, R. N. (1990). *Adaptation and environment*. Princeton, NJ: Princeton University Press.
- Buss, D. M. (1995). Evolutionary psychology: A new paradigm for psychological science. *Psychological Inquiry*, 6(1), 1-30.
- Buss, D. M. (2009). How can evolutionary psychology successfully explain personality and individual differences? *Perspectives on Psychological Science*, 4(4), 359-366.
- Buss, D. M., & Reeve, H. K. (2003). Evolutionary psychology and developmental dynamics: Comment on Lickliter and Honeycutt (2003). *Psychological Bulletin*, 129(6), 848-853.
- Carroll, S. B. (2005). *Endless forms most beautiful: The new science of evo devo*. New York: Norton.
- Cosmides, L., & Tooby, J. (1994). Origins of domain-specificity: The evolution of functional organization. In L.A. Hirschfeld & S.A. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture* (pp. 163-228). New York: Oxford University Press.
- Cosmides, L., Tooby, J., & Barkow, J. H. (1992). Introduction: Evolutionary psychology and conceptual integration. In J. H. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 3-15). New York: Oxford University Press.
- Daly, M., & Wilson, M. (1985). Child abuse and other risks of not living with both parents. *Ethology and Sociobiology*, 6(4), 197-210.
- Davies, P. S. (1996). Discovering the functional mesh: On the methods of evolutionary psychology. *Minds and Machines*, 6(4), 559-585.
- Dennett, D. (1995). *Darwin's dangerous idea: Evolution and the meanings of life*. New York: Simon & Schuster.
- Duntley, J. D., & Buss, D. M. (2008). Evolutionary psychology is a metatheory for psychology. *Psychological Inquiry*, 19(1), 30-34.

- Fodor, J. A. (2000). *The mind doesn't work that way: The scope and limits of computational psychology*. Cambridge, MA: MIT Press.
- Gaertner, K. (1990). A third component causing random variability beside environment and genotype: A reason for the limited success of a 30 year long effort to standardize laboratory animals? *Laboratory Animals*, 24(1), 71-77.
- Gottlieb, G. (2000). Environmental and behavioral influences on gene activity. *Current Directions in Psychological Science*, 9(3), 93-102.
- Griswold, C. K. (2006). Pleiotropic mutation, modularity, and evolvability. *Evolution & Development*, 8(1), 81-93.
- Hall, B. K., & Olson, W. M. (2003). Introduction: Evolutionary developmental mechanisms. In B. K. Hall & W. M. Olson (Eds.), *Keywords and concepts in evolutionary developmental biology* (pp. xii-xvi). Cambridge, MA: Harvard University Press.
- Hamilton, W. D. (1964). The genetical evolution of social behavior. *Journal of Theoretical Biology*, 7(1), 1-52.
- Kauffman, S. A. (1993). *The origins of order: Self-organization and selection in evolution*. New York: Oxford University Press.
- Kenrick, D. T. (2001). Evolutionary psychology, cognitive science, and dynamical systems: Building an integrative paradigm. *Current Directions in Psychological Science*, 10(1), 13-17.
- Ketelaar, T., & Ellis, B. J. (2000). Are evolutionary explanations unfalsifiable? Evolutionary psychology and the Lakatosian philosophy of science. *Psychological Inquiry*, 11(1), 1-21.
- Lakatos, I. (1970). Falsification and the methodology of scientific research programmes. In I. Lakatos & A. Musgrave (Eds.), *Criticism and the growth of knowledge* (pp. 91-196). Cambridge, UK: Cambridge University Press.
- Lewontin, R. C. (1998). The evolution of cognition: Questions we will never answer. In D. Scarborough & S. Sternberg (Eds.), *Methods, models, and conceptual issues: An invitation to cognitive science* (Vol. 4, pp. 107-132). Cambridge, MA: MIT Press.
- Lickliter, R., & Honeycutt, H. (2003). Developmental dynamics: Toward a biologically plausible evolutionary psychology. *Psychological Bulletin*, 129(6), 819-835.
- Looren de Jong, H., & Van der Steen, W. J. (1998). Biological thinking in evolutionary psychology: Rockbottom or quicksand? *Philosophical Psychology*, 11(2), 183-205.
- Molenaar, P. C. M., Boomsma, D. I., & Dolan, C. V. (1993). A third source of developmental differences. *Behavior Genetics*, 23(6), 519-524.
- Nowak, M. A. (2006). Five rules for the evolution of cooperation. *Science*, 314(5805), 1560-1563.
- Platek, S. M., Keenan, J. P., & Shackelford, T. K. (Eds.) (2007). *Evolutionary cognitive neuroscience*. Cambridge, MA: MIT Press.
- 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), 1-18.
- Richardson, R. C. (1996). The prospects for an evolutionary psychology: Human language and human reasoning. *Minds and Machines*, 6(4), 541-557.
- Schmitt, D. P., & 118 Members of the International Sexuality Description Project. (2003). Universal sex differences in the desire for sexual variety: Tests from 52 nations, 6 continents, and 13 islands. *Journal of Personality and Social Psychology*, 85(1), 85-104.
- Schmitt, D. P., & Pilcher, J. J. (2004). Evaluating evidence of psychological adaptation: How do we know one when we see one? *Psychological Science*, 15(10), 643-649.

- Searle, J. (1990). Is the brain a digital computer? *Proceedings and Addresses of the American Philosophical Association*, 64(3), 21-37.
- Seligman, M. E. P. (1970). On the generality of the laws of learning. *Psychological Review*, 77(5), 406-418.
- Stadler, B. M. R., Stadler, P. F., Wagner, G. P., & Fontana, W. (2001). The topology of the possible: Formal spaces underlying the patterns of evolutionary change. *Journal of Theoretical Biology*, 213(1), 241-274.
- Tooby, J., & Cosmides, L. (1990). On the universality of human nature and the uniqueness of the individual: The role of genetics and adaptation. *Journal of Personality*, 58(1), 17-67.
- Tooby, J., & Cosmides, L. (1992). The psychological foundations of culture. In J. H. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 19-136). New York: Oxford University Press.
- Trivers, R. (1971). The evolution of reciprocal altruism. *Quarterly Journal of Biology*, 46(1), 35-57.
- Trivers, R. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man: 1871-1971* (pp. 136-179). Chicago: Aldine.
- Wilson, D. S. (1994). Adaptive genetic variation and human evolutionary psychology. *Ethology and Sociobiology*, 15(4), 219-235.
- Zhang, X.-S., & Hill, W. G. (2005). Genetic variability under mutation-selection balance. *Trends in Ecology and Evolution*, 20(9), 468-470.