
Mestizaje

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Meta-heuristics

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Meta-heuristics is the most recent development in approximate search methods for solving complex optimization problems that arise in business, commerce, engineering, industry, and many other areas. A meta-heuristic guides a subordinate heuristic using concepts derived from artificial intelligence, biological, mathematical, natural, and physical sciences to improve their performance. Notable examples of meta-heuristics include genetic/evolutionary algorithms, Tabu search, simulated annealing, variable neighborhood search, GRASP, and ant colony optimization, among many others (see *Meta-heuristics: theory and applications*, I. H. Osman and J. P. Kelly ed. Kluwer Academic Publishers, 1996).

Metaphysical Theology

► [Natural Theology](#)

Metaphysics

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The science of “first principles” or “first causes” as laid out by Aristotle in his book *Metaphysics*.

Much of the development of modern physics has proceeded from an empirical refinement through mathematical modeling or empirical investigation of theoretical propositions that can be defined as “metaphysical.” Aristotle regarded metaphysics in much the same way as modern philosophy of science regards the practice of science. The philosophy of science studies and analyzes the theoretical premises and procedures as well as the general ground plan of knowledge that enter into the pursuit of science as an empirical discipline. Today metaphysics is a separate branch of philosophy that no longer enjoys the prestige it possessed in its heyday up until the early nineteenth century. The philosopher Immanuel Kant redefined metaphysics as an inquiry into the foundations of how knowledge as a whole is gained, making it an appendage of *epistemology*, the theory of knowledge. In this view, the “first principles” of philosophy can no longer count as basic elements of the universe itself, but as rules or assumptions for how we can come to know the universe in a reliable fashion.

Cross-References

- [Mathematics, Ancient and Medieval](#)
- [New Age Religions](#)
- [Ontology](#)

Metaphysics, Darwinian

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Related Terms

[Darwinism](#); [Universal](#)

Description

“Darwinian metaphysics” may be seen as a compound of two antonyms, since Darwinism

has often been treated as a scientific theory opposing religious and philosophical kinds of metaphysics. Correspondingly, the use of such term may appear provocative, almost as if one were using “Darwinian religion” to designate a general Darwinian approach. The approach and the term itself, therefore, are bound to elicit criticism from positivistic as well as metaphysical positions. Nevertheless, “Darwinian metaphysics” appears to be a suitable term for all historic or recent approaches claiming that Darwinian processes essentially offer a universal account of biology, culture, and our very being. Although Charles Darwin did indeed mainly concentrate on biology, he speculated that his theory would at least “give zest [...] to whole metaphysics” (Notebook B, p. 228). Before we discuss Darwinian metaphysics in the narrow sense, based on a radicalization of Darwinism, we will briefly discuss the proposition that in fact several quite different approaches may be interpreted as Darwinian metaphysics.

Darwinian metaphysics in a *broad sense* is difficult to characterize, since throughout intellectual history “Darwinism” has been presented in different forms and has been used to build syntheses with many other ideas. For instance, Darwinism, even if defined as a biological theory of natural selection, has had an influence on quite different kinds of social Darwinism, from *laissez-faire* capitalism to racism to anarchism. Likewise, historians have linked Darwinism to many philosophical systems – for instance, to that of Herbert Spencer, Ernst Haeckel, William James, and Charles Sanders Peirce. Furthermore, although Darwinism sometimes seems to be linked to progress (at least in the sense of adaptation), Darwinism allows for *local* adaptation only and hence is generally considered to preclude the possibility of genuine progress (see, e.g., Gould 2002) – not least because the process underlying evolution is interpreted to remain essentially static (see, e.g., von Sydow 2012). Likewise, since apparent purpose seems actually to be based on a blind mechanism, Darwinism has sometimes been interpreted as a nihilist doctrine. Darwinism, with the central concept of struggle for life, particularly among

conspecifics, appears to emphasize conflict over cooperation. Moreover, Darwinism at least probabilistically seems to have been correlated with materialism and atheism. Yet one should also note that from the very formulation of Darwinism there have been attempts to interpret natural selection in the opposite direction, linking natural selection to God’s invisible hand. Historically, the relationship between science and religion has been more volatile and intricate than today’s actual conflict between a radicalized Darwinism and a radicalized religious fundamentalism would suggest. Darwin himself not only studied theology at the University of Cambridge, but he in fact seems to have aimed at retaining some aspects of William Paley’s natural theology in his elaboration of the theory of natural selection (even though the theory indeed contributed later both to Darwin’s own increasing agnosticism and a quick decline in the estimation of Paleyan natural theology; see von Sydow 2005).

It is important to distinguish Darwinism from evolutionary theory as such (evolution was advocated in different schools in France and Germany before the publication of *The Origin of Species*). Furthermore, some philosophers (such as Teilhard de Chardin, Henri Bergson, and Alfred North Whitehead) made interesting proposals for a “metaphysics of evolution” that must be seen in contrast to any “Darwinian metaphysics.” On the whole, the relevance of biological Darwinism to ethical or religious issues is highly controversial. There was reaction against the influence of Darwin in the fields of philosophy as well as theology, as well as objection on the part of several authors to the asserted direct relevance of biological theories to ethics (e.g., G. E. Moore) or revealed religion (e.g., K. Barth). Whether one can postulate an epistemic autonomy of these disciplines, however, seems to depend on one’s preexisting logical, epistemic, ontological positions, and also on the details of one’s biological account. Correspondingly, different sub-paradigms of Darwinism displayed different views on the autonomy of culture or ethics. Theories that can be characterized (at least partly) as Darwinian, such as Darwin’s first formulation of Darwinism, Weismann’s neo-Darwinism, the

early evolutionary synthesis, the late evolutionary synthesis, gene-Darwinian sociobiology, and multilevel-Darwinism, held different positions with respect to reductionism and the autonomy of sociology and ethics (see, e.g., von Sydow 2012). Overall, the heterogeneity of thought on Darwinian metaphysics has two main reasons: first, the variation of underlying biological theories and second, the fact that “auxiliary hypotheses” needed to link Darwinism to metaphysics sprang from various traditions.

Darwinian metaphysics in a more *narrow sense* is based on a “purer” Darwinism and (less pluralistic) understanding of the theory. K. R. Popper, D. Campbell, R. Dawkins, D. C. Dennett, and (arguably) D. Hull may be cited as main proponents of this Darwinian metaphysics – of which two types need to be distinguished: gene-Darwinism and (universal) process-Darwinism.

The first type, *gene-Darwinism*, is a radical interpretation of Darwinism that became popular in the 1970s. Its basic ideas have been popularized, particularly by R. Dawkins and G. C. Williams. Pure gene-Darwinism reduces living entities and processes in the biological and social worlds to single selfish genes in Darwinian processes struggling for survival (for a critical survey, see von Sydow 2012). Phenotypes as well as products of organisms, such as beavers’ dams or human habitation structures (so-called extended phenotypes) are interpreted as mere ephemeral vehicles of potentially immortal selfish genes (Hull and colleagues deviates on the issue of vehicles and sees them as interactors, Hull et al. 2001). In the words of R. Dawkins, just as “Chicago gangsters, our genes have survived, in some cases for millions of years, in a highly competitive world. This entitles us to expect certain qualities in our genes. I shall argue that a predominant quality to be expected in a successful gene is ruthless selfishness. This gene selfishness will usually give rise to selfishness in individual behaviour.” (*The Selfish Gene*, 1976, p. 2; cf. Dawkins 1983). One reason to regard gene-Darwinism as a purification or radicalization of Darwinism is that one defining aspect of traditional Darwinism (at least Darwin’s

Darwinism) is a reductionist stance in the units of selection debate by a primary focus on individuals (which, according to Gould 2002, is one of three defining aspects of Darwinism). The focus on selfish genes (gene-reductionism) thus radicalizes the reductive tendency inherent in traditional Darwinism as well. Moreover, like Darwin’s Darwinism has been contrasted to earlier romantic accounts, which stressed the “evolution” or “unfolding” of nature and the role of form and structure, gene-Darwinism in a second sense radicalizes Darwinism in this respect as well, by degrading phenotypes to puppets or mere vehicles of genes (germ-line reductionism). Finally, whereas paradigms that were perceived as Darwinian (such as Darwin’s Darwinism and the evolutionary synthesis in its later phase) remained to advocate a limited process-pluralism, gene-Darwinism reduces all evolutionary processes to the only truly Darwinian process of natural selection (process reductionism). For example, sexual selection from the perspective of single genes cannot be seen as a mechanism in its own right (referring to a special kind of what one may call auto-selection); rather, the process becomes identical to natural selection (both equally referring to hetero-selection). It may even be argued that the entity “gene” – or, more abstractly, the entity of an atomic “replicator” (see Dawkins 1983) – directly corresponds to or is equivalent to a Darwinian process of replication, blind variation, and external selection (von Sydow 2012). However that may be, according to gene-Darwinism there is essentially only one entity – the selfish gene – and only one evolutionary process – a Darwinian process. God, according to universal Darwinism at best is a blind watchmaker. The question of whether Dawkins and Dennett’s prominent critiques of religious thought are directly linked to this position may remain open (*The God Delusion*, 2006; *Breaking the Spell*, 2006). Nevertheless, if one advocates a pure gene-Darwinian position and takes up the sociobiological battle cry to “biologize” social sciences and ethics (E. O. Wilson), one ought not be surprised when several gene-Darwinian authors (despite R. Dawkins’ more cautious

Metaphysics, Darwinian, Table 1 Process-Darwinism and specific Darwinian processes in selected disciplines

Discipline	Object of evolution	Darwinian processes	Authors
Biology	Genes	Blind mutation and natural selection	G. C. Williams, R. Dawkins
Psychology	Operants, acts, associations	Trial and error	B. F. Skinner, D. T. Campbell
Philosophy of science	Theories	Conjectures and refutations	K. R. Popper, S. Tolmin
Economics	Firms, products, routines	Innovation and market selection	M. Friedman

position on ethics) consider maximization of gene-replication as the only ultimate biological categorical “imperative.”

The second type of Darwinian metaphysics is *process-Darwinism*, with roots going back to A. Weismann and C. S. Peirce. Whereas at first Weismann advocated the omnipotence (“Allmacht”) of the one basic process of natural selection, later he postulated several levels of what are now referred to as Darwinian processes. During the course of the twentieth century, the main contributions to process-Darwinism were made by R. Campbell, D. C. Dennett, D. Hull, H. C. Plotkin, K. R. Popper, and R. Dawkins. Process-Darwinism need not be committed to gene-reductionism, and yet it retains as defining characteristic Darwinian process reductionism. Whereas gene-Darwinism allows for natural selection on the single level of selfish genes alone, process-Darwinism claims that these processes exist on several levels, and in fact constitute the only remaining processes of adaptation. D. Campbell (1960), in an early main contribution, advocated that Darwinian processes were the only processes of “knowledge acquisition.” Darwinian processes represented the algorithmic structure of natural selection (in a broad sense) as defined by the two-step process of blind-variation-and-selective-retention (Campbell 1960). The last of the two subprocesses may likewise be called “external selection” or “environmental selection,” since it generalizes natural selection (in the narrow sense). Finally, Darwinian processes are normally assumed to lead to a gradual evolution.

What are the main levels (or domains) in which a process-Darwinian account has been elaborated? Even within biology, the revived

multilevel approach in evolutionary biology, criticizing pure gene-Darwinism (Gould 2002; Wilson and Wilson 2007), assumes (at least in some of its proposals) the central role of Darwinian processes (for instance, on the level of species; cf. the work of M. T. Ghinselin and D. Hull). However this may be, the term “process-Darwinism” is preferably to be used in accounts where Darwinian processes have been advocated outside of evolutionary biology as well. Proposals have been discussed in a number of domains, from immunology, neurology, and language-development to its three main areas: philosophy of science, psychology of trial-and-error learning and creativity, and economics (see Table 1 for an overview).

First, falsificationism, founded by Sir K. R. Popper, had a strong impact in philosophy of science, but was first advocated without explicitly linking it to Darwinism. Popper’s original position is usually introduced based on an asymmetry between verification/confirmation and falsification – a theory taken as a universal statement can never be fully verified by observations but may be falsified by a single one. On this basis, Popper opposed any form of inductive confirmation and argued that scientific theories can be falsified only. Yet in his book, *Objective Knowledge – an Evolutionary Approach* (1972), Popper in fact closely linked his postulated theory of conjecture-and-refutations to Darwinian evolution. Correspondingly, for Popper the development of ideas was irrational and analogous to chance mutation. Likewise, R. Dawkins (1976; cf. 1983) advocated that ideas evolved by a Darwinian process. He coined the term “meme” as analogous to “gene” for atomic replicating and mutating elements of thought that

were the units of selection. Whereas Dawkins assumed a radically reductionist stance within biology, for the meme-level as a whole he appeared to advocate a degree of autonomy. Although the consistency of such a position has been criticized, nevertheless it represents an interesting attempt at reviving the idea of a cultural level, here by replacing with Darwinian processes such traditional notions as “logos,” “spirit,” or “Geist.”

Second, trial-and-error learning (or “operant conditioning”) has been central in psychology to the behaviorist concept of learning. Although one may interpret the rigid research program of behaviorism partly as a bulwark against biology, paradoxically B. Skinner actually postulated that he is introducing a Darwinian process at a second level. The analogy of trial-and-error learning with mutation and selection (or, more correctly, with blind-variation-and-selective-retention) has been explicitly elaborated (Campbell 1960; Hull et al. 2001). Likewise, psychological creativity has been interpreted as a Darwinian process (by D. Campbell and D. K. Simonton; cf. Campbell 1960 and Gabora 2005).

Finally, analogies between neoclassical economics and neo-Darwinian biology have been discussed. Some have treated Popper’s philosophy as founding a philosophy of radical capitalism (although in *The Open Society* he actually allowed for some degree of state intervention). Similarly, the work of M. Friedman, who backed the neoliberal policies of the last decades of the previous century, was partly inspired by Darwinian ideas. Moreover, several proposals in economics have been made that directly refer to the concept of universal Darwinism, where companies or routines have been interpreted as evolving by Darwinian processes, with innovations corresponding to mutations and given consumer preferences to the natural selection by the invisible hand of the market (confer, e.g., Hodgson 2002).

With respect to these Darwinian processes, it is debatable whether their postulated combination (in a process-Darwinian account) in fact yields – implications that are quite non-Darwinian (e.g., non-blind variation at some

level) and; also whether this leads to inconsistencies, thus transcending strict process-Darwinism (von Sydow 2012). Likewise, although process-Darwinism normally continues to stress competition (the struggle for life) over cooperation (both in biology and economics), it should be noted that process-Darwinism allows for the argument that our thoughts, ideas, and theories die instead of us (P. Munz), mitigating a nature red in tooth and claw. Finally, although advocates of process-Darwinism usually subscribe to a naturalistic research program, the emphasis on the algorithmic level of natural selection (cf. works of D. C. Dennett or P. Munch) may be interpreted to go beyond this commitment, basing the theory on a mathematical structure, a form or a principle, rather than on matter or observations.

Let us return, however, to the question of whether it is appropriate to treat these Darwinian theories as metaphysical systems. Depending on one’s understanding of metaphysics, such labeling may either be too high an honor for these sometimes philosophically naïve Darwinian theories – traditionally the highest discipline of philosophy – or else it is too severe a discredit to them to be assigned to a philosophical discipline that from a positivistic viewpoint concerns itself with “meaningless” questions. Many authors today, however, use the term “metaphysics” in a more liberal way, neither necessarily referring to an all-embracing philosophical system set up a priori by a single author, nor accusing metaphysics of being a vacuous system of tautological claims. The term “metaphysics” is not restricted to continental philosophy, but rather has come into use as well in what may still be broadly called “analytical philosophy.” Yet what would be an appropriate reply, if one nevertheless argued that these Darwinian theories were results of plain empirical induction, with no metaphysics involved?

First, historically, Darwin’s great synthesis was clearly not only a great *empirical* synthesis, but a *theoretical* one as well, formulated while ordering the evidence gathered during his journey with the HMS Beagle in the light of available theories of his day (being strongly influenced,

for instance, by Malthus, Paley, Lyell, Grant, etc.). Interestingly, these influences extended to theological approaches (Rev. Malthus and Rev. Paley). Darwin himself acknowledged the influence of William Paley's natural theology, and conceded that everyone with such metaphysical preconceptions would have exaggerated the belief in adaptation and "naturally extend[ed] too far the action of natural selection [...]" (Darwin, *Descent of Man* 1877; cf. von Sydow 2005, p. 154). This is the case, although Darwin's theory of natural selection seems to have dealt a death blow to natural theology as well as to Darwin's own belief. However, Darwin's Darwinism in its initial formulation was even by Darwin's own claims not based on "plain empirical induction" but rather was influenced by theoretical and even theological considerations. Even were this not so, one could still question a presupposed strictly rationalist understanding of metaphysics. Notably, today one hears the term "empirical metaphysics" as well.

Second, gene-Darwinism and process-Darwinism are not generally advocated in the context of a single specific discipline, but rather are universally advocated for all living entities. Attempts have been made to apply gene-Darwinism to "biologize" sociology and ethics. Process-Darwinism has developed for instance in biology, psychology, the history of ideas, and economics. Hence the term "universal Darwinism," introduced by Dawkins (1983), seems appropriate. If generality of the intended field of application is taken as a criterion for a theory's being termed a metaphysical approach, and if another criterion is the abstractness and simplicity of the basic explanatory concepts (for both types of Darwinian metaphysics: Darwinian processes), then we are clearly concerned with metaphysical systems.

Finally, and foremost, the claimed generality of Darwinian processes is to be classified as a metaphysical approach even if one adopts a rationalist understanding of metaphysics based on self-evident principles or a priori truth. In fact, major authors of Darwinian metaphysics (Popper, Campbell, Dawkins, and Dennett) present their approach based on principles or

theoretical arguments, which in a way constitutes a "fundamentalist" position. Paradoxically, Darwinian metaphysics, often depicted as empirical generalization or a positivist "success story," actually seems to revive the rationalist project of an ultimate theoretical justification of a metaphysical position based on first principles. It may suffice here simply to mention Popper and Dawkins. Popper did not argue inductively in favor of a high generality of Darwinian processes, but instead advocated their universality in principle. His argument is in fact based on logical considerations – the above-mentioned logical asymmetry of falsification and verification – and is linked to the fundamental problem of induction that is often attributed to the philosopher David Hume (see below). It is only on this basis that Popper could argue in such a general way that the "growth of our knowledge is the result of a process closely resembling what Darwin called 'natural selection'; that is, the natural selection of hypotheses: our knowledge consists, at every moment, of those surviving so far in their struggle for existence; a competitive struggle which eliminates those hypotheses which are unfit. [...] The theory of knowledge which I wish to propose is a largely Darwinian theory of the "growth of knowledge. From the amoeba to Einstein, the growth of knowledge is always the same [...]" (Popper 1972, p. 261). Dawkins as well seems to be committed to a rationalist foundation of universal Darwinism, making it a truly metaphysical account (1983). He claimed that Darwinism is not only empirically, but also theoretically "probably the only theory that *can* adequately account for phenomena that we associate with life" [italics added]. Other explanations were "in principle incapable of [...] explaining the evolution of organized, adaptive complexity" (pp. 403, 404). Dawkins has argued against any form of instructivism: "Even if acquired characters are inherited on some planet, evolution there will still rely on a Darwinian guide for its adaptive direction" (p. 409).

In this last section, two theoretical reasons will briefly be considered for assuming a Darwinian metaphysics. First, a main "metaphysical" argument favoring Darwinian metaphysics is linked

to the fundamental problem of induction often attributed to David Hume in the eighteenth century. This problem may have had an even longer history: For in scholastic philosophy, first formulations of the problem were paradoxically used to support religious or rationalist positions against empirical ones. Hume, however, with the goal of justifying empirical induction, showed that one cannot “prove that those instances, of which we have had no experience, resemble those, of which we have had experience” (*A Treatise of Human Nature*, 1739/1740, Book I, Part III, sec. VI). Nature may change its course and our inductions rendered false. This in fact implies that all our knowledge, including such a simple and apparently well supported claim as “the sun will rise tomorrow,” may be fallacious. Popper concluded that no confirmation of a theory will ever make a theory “truer” or only more “probable” than a less supported alternative (provided the alternative has not already been falsified). Accordingly, there are no true or probable theories – only theories that have or have not been falsified. Such a “negative solution” to the problem of induction in Popper’s logic of discovery asserts that scientists in fact make blind conjectures and that they should rather aim solely at refutations (falsifications). This, moreover, supports a universal justification for Darwinian processes of blind conjectures and environmental refutations.

The fundamental problem of induction is a highly intricate and hotly disputed issue in philosophy and cannot be treated in any further detail here. Yet it must be noted that Popper’s position is highly controversial in philosophy of science (starting with early criticism by W. V. O. Quine, H. Putnam, and I. Lakatos). Several authors, for instance, have argued that the postulated asymmetry of confirmation and disconfirmation does not hold with regard to complex or compound theories (where it is not clear which aspect of a theory is to be falsified), nor with respect to probabilistic relationships (as they cannot be falsified by single disconfirmations). Moreover, one may object to the link between the problem of induction and falsificationism: Although plain falsification of a formerly

“valid” rule deductively proves that the rule does not hold overall, a falsification applied to the past rule does not logically prove that the rule may not hold in the future. If one assumes that prediction is essential to organisms as well as to scientists, the problem of induction seems to apply equally to falsifications. Although the problem of induction remains fundamental, it may therefore be argued that this problem does not necessary favor a falsificationist approach over a confirmatory one. Furthermore, in recent years there has been a revival of Bayesian approaches, both in philosophy of science (e.g., C. Howson and P. Urbach) and in psychology (e.g., M. Oaksford and N. Chater); that is, it is argued that people, when testing logical hypotheses, search for data in a rational, informed, and more active way than would follow on the basis of Darwinian processes alone.

The second way, Darwinian metaphysics may have gained plausibility (at least in popular writings) may be linked to the unclear meaning of the phrase “survival of the fittest.” Darwin borrowed this expression from H. Spencer in 1869 as a synonym for “natural selection.” Yet, although it appears on the surface to be both testable and plausible, it may be also be interpreted as a tautology: That is, if fitness is interpreted in terms of survival, this results in the phrase of the “survival of the survivor.” More refined definitions are of course possible and have been proposed. For instance, “fitness” is often defined in terms of reproduction, but this does not in fact resolve the problem, since one would then be obliged to measure the term “survival” in terms of reproduction as well (in order to avoid a formulation that is plainly false). Similarly, one may consider a probabilistic formulation of fitness. Once again one would need to look at both sides of the phrase which once again would produce a truism: “those organisms probably survive which probably survive.” The possible problems arising from these “improved” reformulations may in fact question whether “survival of the fittest” is always being used in testable way. It is of course beyond reasonable doubt that evolution and the Darwinian evolutionary theory provide a plethora of testable and

very well tested theories. Nonetheless, it seems plausible that at times it is only more specific theories that are tested, leaving the “survival of the fittest” as an explanatory framework rather than as a testable theory. Nonetheless, it is not claimed here that “survival of the fittest” is always and necessarily used in a tautological way. Actually, there seem to be ways to define “survival of the fittest” falsifiably, but the tautological meaning, broadly applied, may well have played a role in immunising Darwinism and popular versions of universal Darwinism in particular (von Sydow 2012). As such this seems connected to the observation of biologists Gould and Lewontin that adaptive explanations are sometimes be nothing but ad hoc “just-so-stories.” Interestingly, moreover, it was Popper, among others, who pointed out that a “considerable part of Darwinism is not of the nature of an empirical theory, but is a logical truism” (1972, p. 69). Even though he modified his views on this issue later, this is particularly noteworthy, since he modeled his own approach on an analogy to Darwinism.

Outlined here are only a few possible discussions of the metaphysical arguments, with no claim at providing a definitive result. Significantly, the apparently positivist approach of a universal Darwinism appears to revive the philosophical disputes on metaphysical issues in a way that seems relevant to several scientific domains. Other interesting topics in Darwinian metaphysics (particularly for process-Darwinism) concern conceptual and empirical issues. Are mutations, trials, conjectures, innovations, and new ideas actually strictly blind? Is selection strictly external or environmental? Is variation supplemented by synthesis? Could combinations of Darwinian processes result in irreducibly non-Darwinian processes? Is there top-down causation of emerging entities and processes? These are controversial matters, partly raised concurrently in varying domains of process-Darwinism (e.g., Gabora 2005; Hodgson 2002; von Sydow 2012). This, however, brings us back to the earlier point made about tautological definitions. That is, it may depend on our definition whether we define Darwinian processes so widely that Darwinian metaphysics

become almost a truism, or whether we define them as rigidly as possible, with the result that they become false almost by definition. Within metaphysics, one generally preaches to the converted if one argues that – besides factual issues – definitional issues often decide over the truth or falsity of theories or even of metaphysical systems of theories. However, in Darwinian metaphysics it seems clear that a greater awareness of definitional practices and implications may be helpful.

Cross-References

- [Biology](#)
- [Conditioning and Learning](#)
- [Divine Creativity](#)
- [Epistemology, Evolutionary](#)
- [Evolutionary Theology](#)
- [Natural Selection](#)
- [Natural Theology](#)
- [Reductionism](#)
- [Scientism](#)

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Method

- ▶ [Naturalism, Ontological and Methodological](#)
- ▶ [Personhood and Scientific Methodology](#)

Methodology in Psychology

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Related Terms

[Research design](#); [Research methods](#)

Description

Methodology in psychology refers to procedures researchers use to answer specific questions. There is no single methodology that all psychologists use. Instead, different schools and disciplines within psychology employ specific methods, some unique to a given discipline, while others are common across disciplines (Todd et al. 2004). For instance, for many psychologists, methodology refers to procedures and designs that permit the identification of causal relationships between independently defined variables. An explicit method by which such relationships are identified assures that other researchers can produce

identical results using the same procedures. This produces the single most important criterion identifying a discipline as a science, the public replication of causal claims. Thus, the major criteria that methodology addresses are repeatable findings by independent investigators in support of nomothetic laws or explanatory principles that apply to all instances of the same type of phenomena (Kuhn 1962; Motterling 1999). These laws are considered the scientific explanation of the phenomena studied. These assumptions and procedures are shared by psychologists who consider psychology to be a natural science (Roth 1987).

However, psychology is a many-faceted discipline, and not all psychologists consider it to have achieved the status of a natural science, and others would deny that it ought to strive to be one. Thus, there are a variety of methodologies used in psychology, each with its benefits and costs and all implying a particular set of assumptions regarding the nature of psychology. The assumption that psychology is or ought to be a natural science can be contrasted with the assumption that psychology is a human science (Denizen and Lincoln 2002; Wallerstein 1992). Those who identify psychology as a human science employ methods that are linked to the assumption that human beings are unique and have characteristics that are not reducible to the parameters of natural science. These psychologists have devised a variety of methodologies that do not simply focus upon causal relationships. Thus, contemporary psychology is characterized by methodological pluralism. No single method can be adopted uncritically; rather, methods are linked to assumptions investigators make about the nature of psychology and to the kind of questions they seek to answer. For instance, to ask “Under what conditions do dreams occur?” requires a methodology to identify causation, while to ask “What do dreams mean?” requires hermeneutical methods that assume dreams are meaningful phenomena capable of interpretation. This is one cleavage that divides methodology in psychology. Methods designed to identify causal relationships of necessity are quantitative as opposed to qualitative methods. Thus, we begin our discussion of methodology in psychology with quantitative methods.