Published in final edited form as:

Clin Psychol Rev. 2020 November ; 81: 101892. doi:10.1016/j.cpr.2020.101892.

Clinical Psychology is an Applied Evolutionary Science

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Abstract

Historically there has been only a limited relationship between clinical psychology and evolutionary science. This article considers the status of that relationship in light of a modern multi-dimensional and multi-level extended evolutionary approach. Evolution can be purposive and even conscious, and evolutionary principles can give guidance and provide consilience to clinical psychology, especially as it focuses more on processes of change. The time seems ripe to view clinical psychology as an applied evolutionary science.

Keywords

evolution; variation; selection; multi-level selection; extended evolutionary synthesis; conscious evolution; evidence-based therapy; processes of change

Clinical psychology is an empirically and professionally well-established branch of the health and life sciences, but its intellectual connection to evolutionary science is historically limited. A few minutes with a search engine will reveal that the vast scientific literature on psychopathology, psychotherapy, processes of change, or diagnosis, seldom mentions evolutionary principles as topics of critical contemporary relevance.

This simple fact presents a paradox of disconnection. On the one hand, belief in evolution by behavioral scientists, indeed by scientists of all kinds, is nearly universal (Pew Research Center, 2009). It is difficult to find clear written statements by any clinical psychologist of note suggesting that their field, or their specific approach to their field, does *not* comport with an evolutionary perspective. On the other hand, it is relatively uncommon to find evolutionary principles being studied or used within well-established clinical psychological perspectives, or within mental health more broadly (Nesse, 2019). With only a few exceptions (c.f., Hayes & Hofmann, 2018), introductory texts in clinical psychology say little about principles of evolutionary science other than description of genetics in the obligatory chapter on the biological bases of behavior.

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It seems important to dig out the source of this paradox: how can the data, theory, and practice of contemporary clinical psychology need to cohere with evolution, but a thoughtful examination of evolutionary science be of limited actual value to the field? It appears to be based on the idea that the role of evolution is already subsumed within biological influences over behavior, and thus as long as clinical psychology draws upon genetic, neuroscience, or other biological knowledge, evolutionary theory *per se* is not of additional importance. After all, the Darwinian revolution took place long ago (so would go this line of thought) and it is a given to understand the origin of species. Genes evolve and they influence behavior. What more is there to know?

It turns out there is a great deal more to know. The impact of genes on behavior is complex and pervasive (Crespi, this issue), but genes are being up and down regulated by epigenetic processes, some heritable, that are highly sensitive to environment and behavior (Jablonka & Lamb, 2014; Schiele, Gottschalk, & Domschke, this issue). Evolutionary principles apply to development (Horn, Carter, & Ellis, this issue; West-Eberhard, 2003), the behavior of small groups (Wilson & Coan, this issue; Wilson & Wilson, 2008), and cultural factors (Biglan, Johansson, Van Ryzin, & Embry, this issue; Kohrt, Ottman, Panter-Brick, Konner, & Patel, this issue). Issues of learning, cognition, or behavior are contemporary topics within evolutionary science itself (Bronfman, Ginsburg, & Jablonka, 2018). Some of the procedures or processes commonly studied by clinical psychologists are known to impact key aspects of evolutionary development, and evolutionary principles in turn can help clinical psychological research and practice in multiple areas (e.g., Andrews, Maslej, Thomson, & Hollon, this issue; Hayes, Hofmann, & Ciarrochi, this issue).

There is a great deal more to know.

The Problem of Consilience

Mature sciences share assumptions and analytic units in ways that allow progress in one area to support progress in another. Historically clinical psychology, as in psychology more generally, has had a difficult time functioning in that way. The field is divided by theoretical models, which are so dominant that people who champion these models have a hard time even talking to each other in meaningful ways. Diagnosis and assessment have limited known treatment utility; treatment packages for one diagnostic group do not need to cohere with packages for another; interventions focused on one setting, age, or population need say little about interventions focused on another setting, age, or population.

In the rest of the life sciences these problems of disconnection are often solved or at least ameliorated by the consilience provided by evolutionary theory. The heart is not the same as the lung, but organs and organ systems co-evolved and their functional interaction are studied and understood within an evolutionary framework. In essence, evolutionary principles serve as a process account to help life scientists understand the variety of phenotypic forms and their functions and history.

That is not yet true in clinical psychology, but we argue that change is possible. Clinical psychology is arguably turning in a more process-based direction as confidence in

syndromal classification weakens and a initiatives such as the “Research Domain Criteria” of the National Institute of Mental Health (RDoC; Insel et al., 2010) impact the field (Hofmann & Hayes, 2020). Disparate process explanations can turn into a cacophony without an overarching model. That unifying role is satisfied in the rest of the life sciences by evolutionary theory and we argue that it can serve such a role in clinical psychology as well, once the features of modern evolutionary science are explicitly understood.

In what follows we will attempt to establish the importance to clinical psychology of a modern evolutionary approach that is multidimensional, multi-level, and focused on a well-rounded set of questions, which can be used in a purposive and conscious fashion. We will briefly present the features of an extended meta-model that seems capable guiding diagnosis and intervention in clinical psychology by organizing change processes in terms of evolutionary principles. This, we hope, begins to show how evolutionary science can increase the consilience of clinical psychology itself, and well as better integrating it into the family of life sciences.

Defining a Darwinian Evolutionary Process

Darwin’s essential insight, which distinguished his theory from previous theories of evolution, was to focus on the three ingredients of *variation*, *selection*, and *heritability*, needed for adaptation. Any process that includes these three ingredients can be called Darwinian and can be studied with a common set of methods.

Darwin knew nothing about genes. For him, heritability was defined as a resemblance between parents and offspring. The retention of traits across generations was well established in Darwin’s day, even if the underlying mechanisms were unknown.

Mendel was a contemporary of Darwin but the significance of his work was not recognized until later. The rediscovery of genes in the early 20th century was a breakthrough in our understanding of the mechanism of one form of heritability, but it had an unintended consequence. Genes quickly became treated as the only mechanism of inheritance, as if the only way for offspring to retain features of their parents is by sharing genes.

The Rise of Gene Centrism

The core idea behind gene centrism is patently false. It has always been obvious that genes alone do not account for the inherited retention of traits. Offspring generally share the same language as their parents, for example, which has nothing to do with sharing genes, other than the likelihood that there are genes related to processes of language acquisition that are shared by all humans. More broadly, offspring share the same cultures as their parents, which also has nothing to do with sharing genes, other than the genetic basis for the learning and social processes that support cultural transmission that are shared by all humans.

Nevertheless, the precision and human potential of genetic knowledge captured the focus of evolutionary biology. From the middle of the last century forward, natural selection, Mendelian, and population genetics combined into the so-called Modern Synthesis (Huxley, 1942), which organized evolutionary science research for several decades. As grant money

and human capital flowed in, evolutionary science itself became highly constricted during the last half of the 20th century, unfortunately in ways that limited its relevance to psychology and its clinical applications beyond the soon to be revealed nature of the human genome. In particular, once the structure of DNA was identified (Watson & Crick, 1953), it was obvious that there was an enormous amount to learn about how DNA works, how RNA transcribes DNA, how transcription errors are corrected, how genetic messages are passed on within the cell, and so on.

During this highly gene-centric era of evolutionary science, people were sometimes viewed as part of the life cycle of genes, mere pawns in a game of survival played among sequences of nucleotides (e.g., Dawkins, 1976). Evolution itself was commonly defined as a “change in gene frequencies in a species due to selective survival” (Bridgeman, 2003, p. 325). In the heyday of this era, it seemed entirely reasonable that many if not most diseases and behavioral problems would ultimately be revealed to be genetic in a fairly straightforward Mendelian way. By the mid 1980’s serious efforts were underway to acquire the funds and technology needed to map the entire human genome and by 1990 the project itself had begun. After years of effort, and with more than \$1 billion dollars spent, all 3 billion bases in the human genome were finally decoded (International Human Genome Sequencing Consortium, 2004).

The Fall of Gene Centrism

Large genomic projects followed, and at a quickening pace as the cost of genomic mapping fell. Studies appeared with hundreds, then thousands, then hundreds of thousands of participants. While it cost 2.7 billion dollars and 13 years to map the first full human genome, in the modern era a full genomic analysis of an individual can be completed in a day for several hundred dollars. As data gathered, however, it soon became very clear that a straightforward Mendelian link between a small number of genes and a complex human trait would be rare.

It is now clear that genes do not code for phenotypes in any simple or direct sense – rather they do so through vast gene systems that are themselves impacted by a complex network of biopsychosocial and environmental factors (Jablonka & Lamb, 2014). Genomic analyses based on several hundred thousand participants show that even a simple phenotypic trait such as physical height may involve several hundred genetic loci, and still account only for a portion of the variance in the trait (Wood et al., 2014). The result is that some argue that “for complex traits, association signals tend to be spread across most of the genome” meaning that genetic impact on complex traits may not necessarily even be polygenetic, that is, based on large integrated sets or systems of genes – but may involve the entire genome, an approach termed “omnigenetic” (Boyle, Li, & Pritchard, 2017). Although this sounds new, it really is not. For example, the evolutionary biologist Ernst Mayr, while criticizing a gene-centric account such as Dawkins, argued that such an approach is more in the spirit of Darwin because the target of selection “is really the whole genotype of the individual, not the gene” (2001).

Genes are critically important inputs into psychological actions of all kinds (see Andrews et al., this issue), but they are not the only unit of importance in evolutionary science. A more

multi-dimensional and extended view, organized under Darwin's major ingredients but now with more dimensions and features, became more plausible. It is the *extended evolutionary synthesis* (e.g., Laland et al., 2015; Pigliucci, 2007) that most opens the door to much greater relevance of evolutionary science to clinical psychology, and to clinical psychology as a valued member of the evolutionary sciences.

The Inclusion of Mind and Behavior in a Multidimensional Evolutionary Approach

In order to bring evolutionary principles into clinical psychology it is clear that a multi-dimensional approach is needed: one that includes multiple biological dimensions but also extends to all other types of evolutionary strands at all time scales. While it is indeed true that "nothing in biology makes sense except in the light of evolution," as Dobzhansky (1973) famously said in the title of an essay, evolutionary principles arguably apply as much to behavior, thought, or culture as they do to biology per se (Jablonka & Lamb, 2014). At the least, a multidimensional approach needs to include all four of the trans-generational evolutionary strands discussed by Jablonka and Lamb: genetic, epigenetic, forms of social learning found in many species, and forms of symbolic thought that are arguably distinctively human.

Epigenetic factors have had a particularly central impact on a multi-dimensional approach to evolutionary research. The term refers broadly to biological processes that regulate gene activity, expression, transcription, and function. The greatest research interest has been in heritable epigenetic processes such as the methylation of cytosine (Jang, Shin, Lee, & Do, 2017), which makes regions of DNA difficult to transcribe (Jablonka & Lamb, 2014). In recent years there has been an explosion of research in epigenetic mechanisms of this kind, across a range of processes known to influence gene expression (Kim, Samaranyake, & Pradhan, 2009). Importantly, it is increasingly clear that the biological regulation of gene expression is responsive to features of environment and behavior, such as parental care (e.g., Champagne, 2008).

Epigenetic Factors

The paper by Schiele et al. (this issue) describes the rapid development in epigenetic research as it applies to the kinds of topics relevant to psychological change. A transformative idea has gradually emerged from such data. It is now possible to think of physical organisms themselves as systems for turning environment and behavior into biology (Slavich & Cole, 2013). This idea, drawn initially from epigenetic research, not only makes an evolutionary perspective more relevant to clinical psychology, it makes psychology more relevant to evolutionary perspectives. For example, a short course of mindfulness meditation has been shown to turn on or off over a thousand genes in the human body via epigenetic mechanisms (Dusek et al., 2008). Other experiences that impact mental health have also been shown to have epigenetic effects (e.g., Uddin & Sipahi, 2013). Learning and memory appears to have major epigenetic inputs (Levenson & Sweatt, 2005). Thus, a clinical psychologist interested in, say, meditation or learning now needs to consider the possibility that these psychological events are dynamically altering gene expression. It is no longer

possible to speak of, say, genetic inputs to clinical phenomena without adding a second arrowhead to that relation.

Sociocultural Factors

Appreciation for the dynamic interaction between multiple evolving dimensions has occurred in other areas of a multi-dimensional evolutionary perspective. The study of social behavioral cultural inheritance mechanisms in evolutionary science, for example, has a very long pedigree, taking hold in the middle part of the last century with research on the cultural practices of non-human animals (e.g., Bonner, 1980). A famous example is supplied by the innovations of a single individual female macaque who learned to wash sand off potato slices by dipping them a river (Kawai, 1965) and later learned to add salt to these slices by dipping them in the sea, practices that eventually spread through the troop and continued long after the innovator died (Hirata, Watanabe, & Kawai, 2001).

This simple example of the evolution of cultural practices makes it obvious that a full account requires inclusion of Darwinian processes that take place rapidly (compared to genetic evolution) and within an organism during its lifetime. There are a number of such processes, such as adaptive components of the immune system, behaviors that evolve by operant conditioning, the selection of symbolic meaning systems, neural development, or other physiological and neurobiological processes that are being discovered to be Darwinian during the course of development (Wilson, Hayes, Biglan, & Embry, 2014). In much the same way that the regulation of gene expression makes epigenetic processes important, cultural evolution reveals how long lasting and important fast evolutionary processes of this kind can be.

For example, the creative behavioral variations of washing off sand or adding salt to food were selected by negative and positive reinforcement, respectively, at the level of the individual innovator. Other members of the troop initially acquired this practice through social learning, but the practice was soon modified via operant conditioning. Other members of the troop began redipping the potatoes into the sea after each bite, for instance, something the innovator did not initially do, suggesting that salt itself began to select new behavioral variants (Hirata et al., 2001). The study of human cultural practices includes many such examples (Turchin, 2015), and changes in cultural practices in turn modify the selection pressures impacting on genetic evolution itself (Henrich, 2015).

Behavioral Impact on Evolutionary Processes

As this example shows, it is a mistake to think of evolutionary factors as only operating on behavior, when it is equally true that behavioral and psychological factors operate on evolution. This is an idea with a long history in evolutionary thought and is central to such concepts as the Baldwin effect (Crispo, 2007). The processes of associative and contingency learning appear to be about half a billion years old, based on the fact that all species that evolved since the Cambrian period approximately 541 million years ago show such learning processes, while species that evolved earlier (e.g., slime molds) do not (Ginsburg & Jablonka, 2010). Contingency learning allows organisms to select and maintain contact with particular environments by actions of their own, a phenomenon known as “niche selection.”

As a result, new phenotypic forms could evolve fairly rapidly. For example, once generations of a particular breed of bird was digging in river mud to find edible crustaceans, the evolution of the scoop-shaped and filtering structures of the flamingoes' beak could occur due to variation and selection (Schneider, 2012). Thus, the "Cambrian explosion" in speciation, may actually represent a powerful example of how psychological variables can alter the course of biological evolution (Ginsburg & Jablonka, 2010). Indeed, some have argued that learning can produce complex patterns of behavior that in turn can be enhanced by biological evolution, serving as a kind of "ladder of evolution" (Bateson, 2014). Although not yet fully resolved, there is even evidence that some forms of learning may become trans-generational via epigenetic inheritance (Dias & Ressler, 2014).

Behavioral Products Impact on Evolutionary Processes

Indeed, a multidimensional approach does not stop even with the actions and features of organisms. Actions can also change the environment in direct and long lasting ways that in turn can impact what can or will be selected by evolutionary mechanisms. The phenomenon of "niche construction" points to the fact that the behavior of organisms can alter the environment in long-lasting ways, which in turn can alter how differences between organisms are selected (Odling-Smee, Laland, & Feldman, 2003). The protective features of the beavers' dams, may have selected for the beavers' large tails and tree felling teeth, for example (Odling-Smee, 1995). At a global level, the oxygen produced as a result of photosynthesis by cyanobacteria altered the course of the evolution of life on earth (Erwin, 2008).

Creating a Seat at the Evolutionary Table for Behavioral Processes

The inclusion of behavior and thought in a multidimensional evolutionary approach has profound implications both for psychology and for evolutionary science. Ethology long ago embraced behavioral traits as a legitimate focus of evolutionary analysis since there is valid a priori reason to include structural phenotypic traits such as floppy ears, while waiving away behavioral phenotypic traits such as tameness (a non-random example, since the two traits are correlated; Trut, 1999). The analyses of behavioral traits was based, however, more on phylogenetic processes than on ontogenetic processes, and indeed ontogenetic development, both behavioral and structural, was not readily given its proper role and due weight by evolutionists until more recently (West-Eberhard, 2003).

A poignant example of particular relevance to the behavior therapy tradition was the historical way in which operant learning was treated by evolutionists. B. F. Skinner wrote extensively about evolutionary processes and the overlap between contingencies of reinforcement, survival, and cultural development. The abstract of his 1981 article in *Science* on selection by consequences reads:

Selection by consequences is a causal mode found only in living things, or in machines made by living things. It was first recognized in natural selection, but it also accounts for the shaping and maintenance of the behavior of the individual and the evolution of cultures. In all three of these fields, it replaces explanations based on the causal modes of classical mechanics. The replacement is strongly resisted. Natural selection has now made its case,

but similar delays in recognizing the role of selection in the other fields could deprive us of valuable help in solving the problems which confront us. (p. 501). Skinner was saying that genetic evolution, individual learning, and cultural change all result in behaviors that must be explained not in terms solely of the physical make-up of the organism (“the causal modes of classical mechanics”) but rather based on the functional impact of a history of interactions between the organism and the environment spread across time. The behaviors that result from this historical process tend to adapt organisms to their changing environments—not invariably and in every respect, but to a degree.

Evolutionists of the day largely rejected this as a false analogy (e.g., see the commentaries on this article when it was republished in a special issue of *Behaviour and Brain Sciences* on Skinner’s canonical papers, 1984, 7(4), 480–510). One of the reasons was because the relative strengthening and weakening of actions in a repertoire are difficult to fit into a strict interpretation of inheritance or replication.

Psychologist Donald Campbell suggested a solution with his alternative phraseology of “variation and selective retention” (1960). In order to deal with evolutionary principles across psychogenetic and ontogenetic dimensions, it can be helpful to use that approach. Consider a psychological action, such as telling a particular joke. At the level of the individual it is available to be passed on to others on the basis of its retention in memory, and ability to be evoked by context, due in part to its past history of evoking laughter in others. Any given joke has a relative likelihood of being expressed in competition with other jokes, that is, its telling is based on selective retention within the individual’s repertoire. Some jokes may disappear entirely from the person’s repertoire and if so, they are no longer available to influence other evolutionary streams, such as the prevalence of a joke within the cultural practices of a group. The same point applies to all dimensions of evolution and thus it is helpful to have a term that is more universally applicable among the vastly different time frames to which multidimensional evolutionary concepts are applied in clinical psychology. For that reason, in the remainder of this paper we will use Campbell’s term.

Historical Roots of Disconnection

This promising start in behavioral psychology did not lead to a more adequate interaction between psychology and an evolutionary perspective. It was not just gene centrism that was at fault -- Skinner’s vision was constricted in some key respects. For one thing, he placed so much reliance on selection by consequences that he largely ignored the study of proximate physiological mechanisms. It did not matter that this was due more to focus than philosophy, because that inattention weakened the useful interactions that followed, particularly with more biologically oriented researchers. Perhaps more importantly, Skinner was not very successful in his attempt to explain language and other forms of symbolic thought using only operant principles. Indeed, those two shortcomings help explain why behaviorism fell out of favor in academic psychology more generally during the mid-20th century (c.f., Seligman, 1970).

What happened next, however, was anything but a smooth advancement of knowledge in terms of the relationship of psychology and evolutionary perspectives. As cognitive science emerged, it focused on neurobiological mechanisms that might support hypothesized

cognitive processes, leaving behind behaviorism's historical and functional approach. Both behavioral and cognitive approaches were then severely critiqued by the initial wave of Evolutionary Psychology (Cosmides & Tooby, 1992), which combined them both under the label of the "Standard Social Science Model" and sought to replace them with a "massive modularity" thesis — namely that the human mind was a collection of many domain-specific cognitive devices, which evolved to solve the problems of survival and reproduction in the genetically ancestral environment. The result was that a promising early connection between principles that underlie important wings of clinical psychology and evolutionary principles did not bear fruit.

In some ways, clinical psychology and evidence-based therapy also changed in ways that further undermined a possible connection as it focused more and more on psychotherapy protocols that might impact specific signs and symptoms of psychiatric syndromes. While behavioral approaches fell out of favor in academic psychology, they didn't go extinct largely because they remained vigorous in intervention science where their methods were effective in producing behavioral change. Behavioral approaches were then supplemented (but not replaced) by methods that became known as traditional cognitive behavior therapy (CBT), which in turn was supplemented (but not replaced) by acceptance and mindfulness-based methods. To the degree that these changes were more about technology than principles, the connection between evidence-based intervention and evolutionary principles remained obscure. In a sense, empirical clinical psychology suffered through its own form of modularity, in which multiple technologies sprung up, disconnected one from the other.

The upheaval in CBT since the turn of the century has led to a greater focus on assumptions and principles, however (Hayes & Hofmann, 2017). As clinical psychology and evidence-based intervention moves to a more process-based era (Hofmann & Hayes, 2019), the consilience provided by an evolutionary perspective has become both more needed and more obvious (Hayes, Hofmann et al., 2019; Hayes et al., this issue). The relevance of functional and contextual behavioral science approaches to evolutionary science perspectives is also clearer (Wilson & Hayes, 2018). Together these changes make it more meaningful for clinical psychology to be seated at the table of the evolutionary sciences, both to learn and to have its voice recognized.

The Inclusion of Mind and Behavior in a Multilevel Approach

For clinical psychology to fully benefit from evolutionary science it is important that evolution be seen not just as a multi-dimensional process, but as one that is multi-level. For each evolutionary dimension, selection operates not only on individual units, but on a nested hierarchy of groups.

Because natural selection favors individuals that survive and reproduce better than other individuals, it seems to explain self-oriented traits more easily than group-oriented traits. However, groups of cooperative individuals robustly outcompete groups whose members cannot cohere (Sober & Wilson, 1997; Wilson & Sober, 1994; see Wade, Bijma, Ellen, & Muir, 2010 for an experimental example with chickens). Hence, group-oriented behaviors

can evolve, but only if between-group selection is strong enough to outweigh within-group selection.

This same logic can be extended to multiple-tier hierarchies such as from genes to ecosystems in biological systems and small groups to global governance in human systems. In human terms, what's good for me can be bad for my family. What's good for my family can be bad for my clan. What's good for my clan can be bad for my nation. What's good for my nation can be bad for the global common good.

This is known as multilevel (MLS) selection theory and its general rule is: adaptation at any level of a multi-tier social hierarchy requires a process of selection at that level and tends to be undermined by selection at lower levels (Wilson & Wilson, 2008; see Wilson, 2015 for a concise book-length account). This is profoundly different from the concept of the invisible hand in economics, which claims that the pursuit of lower-level self-interest robustly benefits the common good.

Most social species are a mosaic of self-oriented traits that evolved by within-group selection and group-oriented traits that evolved by between-group selection. The balance between levels of selection is not static, however, but can itself evolve. When mechanisms evolve that suppress disruptive within-group selection to a sufficient degree, then the advantages of group cooperation can dominate to the degree that the group qualifies as a higher-level unit in its own right. This has led to the major transitions of evolution and every entity that we call an organism provides an example, including the first bacterial cells, nucleated cells, multicellular organisms, and social insect colonies such as ant, bees, wasps and termites (along with a handful of other invertebrate and vertebrate species), which are so cooperative that they can validly be called superorganisms.

A nucleated cell, for example, is not a single unit – it is an ancient cooperative system. Mitochondria has distinct DNA from the rest of the cell – it is literally a different life form – but the small group called a “nucleated cell” does better by cooperating. As with any major transition, however, cooperation does not remove selection that can operate at the level of the smaller units of organization. Mitochondrial DNA is replicated only within the maternal line, and even after most of a billion years to get it right, mitochondria still occasionally tricks plants into “male cytoplasmic sterility” so as to produce only females (Chase, 2007). In the same way, multicellular organisms are more than half a billion years old, but cancerous cells still reveal the tendency toward selfishness that exists among these otherwise cooperative cells (Aktipis, 2019).

Humans are one of evolution's newest major transitions. Incidents of disruptive competition within groups is over hundred times more frequent in chimpanzee communities, our closest primate relatives, as compared to human hunter-gatherer societies (Wrangham, 2019). Our distant ancestors found ways to suppress bullying and other forms of disruptive behaviors within groups so that, largely although never entirely, between-group selection became the primary evolutionary force. Nearly everything distinctive about our species is a form of the cooperation that resulted, including our mental capacity for symbolic thought (Hayes & Sanford, 2014) and our resulting ability to transmit large amounts of information across

generations. All integrated repertoires also can be thought of in MLS theory terms (Rachlin, 2019), from cognitive schemas to personality styles. Thus, as an extended evolutionary synthesis is applied to human functioning, the analysis must not only be multi-dimensional, it needs also to be multi-level.

A Common Set of Questions for Studying All Darwinian Processes

In order to apply evolutionary thought to clinical psychology it is not enough to think in a multidimensional and multilevel way – one also has to ask a full range of sensible evolutionary questions. Niko Tinbergen, who shared the Nobel Prize with Konrad Lorenz and Carl von Frisch for pioneering the study of animal behavior, identified four questions that must be addressed for all products of evolution, concerning their function, history, mechanism, and development (Tinbergen, 1963). These can be used to craft a broader research program for clinical psychologists interested in an evolutionary perspective.

In the context of natural selection, *function* concerns the contribution (if any) that a trait makes to survival and reproduction as a result of selection by consequences. The qualification “if any” is important because not all products of evolution are adaptive. There are non-adaptive byproducts of adaptations, products of drift, and adaptations to past environments that have become mismatched to current environments. Even traits that count as adaptive in the evolutionary sense of the word can be injurious in other respects, as we will discuss in more detail below. An example of such a question in clinical psychology is provided by the question asked by Andrews et al. (this issue): whether depression is an evolved emotion that has the function of motivating avoidance of something harmful in the environment.

History concerns the process whereby the trait arose and increased in frequency compared to alternative traits. Because evolution is an historical process, it is influenced by chance events that become compounded over time. In one of the more famous experiments in evolutionary biology, Richard Lenski selected for the same functional trait—the ability to digest glucose—in 12 isolated populations of *E. coli* that were all derived from the same clone (Lenski, Rose, Simpson, & Tadler, 1991). Even though each population started out genetically identical, inhabited the same physical environments, and was selected for the same functional property, the mutations that arose in each population over 2,000 generations were chance events and therefore different from each other. These differences, in turn, led to larger differences until eventually each population became very different in how they adapted to digest lactose and their potential to adapt to other selection pressures.

What Lenski documented in a carefully controlled laboratory experiment takes place all the time in nature. For example, humans have domesticated livestock in numerous places around the world, a case of convergent cultural evolution, creating a genetic selection pressure for the adult ability to digest lactose in each case. The mutations that arose differ between populations, however, just as in Lenski’s experiment on *E. coli*. Thus, modern humans not only vary in their ability to digest lactose, they differ in the specific genetic means by which this is accomplished (Ingram, Mulcare, Itan, Thomas, & Swallow, 2009). As another example, when human problem-solving teams are given the same complex problem to solve,

they typically come up with different solutions and different steps to arrive at a given solution. The alternatives that they nominate during the decision-making process are governed in part by chance, much like genetic mutations. By simulating generational succession through the repeated removal and replacement of human participants within experimental groups, different "microsocieties" can be created with different cultural traditions (Caldwell & Millen, 2008). This is why the history of a trait and the level at which it was selected needs to be understood along with its functional basis. An example of such a question in clinical psychology is an examination of the evolutionary history of loneliness among the social primates called humans (Cacioppo, Cacioppo & Boomsma, 2014).

Mechanism concerns the physical basis of a trait. All traits, including behaviors, have a physical basis, no matter whether they are adaptive or by what historical process they evolved. For example, most species that live in deserts evolve to be sandy colored to avoid being detected by their predators and prey. This statement can be made no matter what the species or its physical makeup, provided only that physical features result from heritable variation that can be shaped by differential survival. To fully understand the coloration of any particular species, however, more than a functional answer is required. Color may be influenced by the polysaccharides in the chitin in an insect's exoskeleton, calcium carbonate in the shell of snails, or eumelanin in the fur of animals. Thus, the functional answer to the question "what explains the color of desert-living species" will be the same for each species, while the mechanistic answer to the same question will be quite different. In clinical psychology, an example is how the methylation of gene systems has helped explain the stress reduction effects of mindfulness meditation (Dusek et al., 2008).

Development refers to the process by which the trait comes into existence during the lifetime of the organism. Almost no trait is retained through time in the same form. It must be broken down and reassembled from building blocks. For example, eye development requires input from the environment. If the eyelids of a kitten are sewn shut during key developmental periods, then profound visual impairment occurs (Hubel & Wiesel, 1970). For eye development to be a reliable process, the appropriate environmental input must be reliably present in the entire range of environments inhabited by humans, from deserts to jungles. For example, the developing eye seeks out vertical, horizontal, and oblique contours which are present in all environments. If kittens are placed in an environment with only vertical contours, profound visual impairment also occurs, even though the eyes were not covered by a patch (Daw & Wyatt, 1976). Remarkably, human-built environments can depart from natural environments in a way that disrupts normal eye development, resulting in high frequencies of near-sightedness (myopia). In particular, normal eye development appears to require ambient light levels that are higher than many indoor environments. The more time spent indoors, the higher the risk of myopia (Guo et al., 2013). An example in clinical psychology is the developmental neurobiology of childhood trauma (Teicher, Andersen, Polcari, Anderson, & Navalta, 2002).

Mayr (1988) divided these questions in a slightly different way, distinguishing between ultimate and proximate causation. Ultimate causation maps onto Tinbergen's function and history questions, while proximate causation maps onto Tinbergen's mechanism and development questions. Both ultimate and proximate causation are relevant to any key

psychological question, and likewise all Darwinian processes are subject to the four-question approach.

While each of Tinbergen's four questions can be studied in isolation to a degree, studying them in conjunction with each other constitutes a fully rounded evolutionary approach. Moreover, as time frames, dimensions, and levels are changed, these questions likewise change their focus. For example, study of neural development may be both a mechanism and developmental issue for a behavioral science, but a neuroscientist trying to ask functional or historical questions about a specific nerve cell, may focus on different mechanisms or steps in development. Thus, the four-question approach is relevant to all levels and dimensions of variation, selection, and retention, but the focus of these questions change as specific features become dominant. For example, a clinician needs to think about a client's personal history, behavioral repertoire, cultural heritage, and genetic ancestry with Tinbergen's four questions in mind, as we will discuss later. It is this combination that leads naturally to new approaches to diagnosis and case conceptualization in clinical psychology (Hayes et al., this issue).

Many of the controversies in psychology (not just those regarding evolution) can be seen as a failure to appreciate the complementarity of Tinbergen's four questions, or the distinction between ultimate and proximate causation. For example, the cognitive revolution that followed behaviorism could have more usefully been seen as adding the study of mechanism and development to the study of function and history, both of which are the forte of behaviorism, rather than a replacement of behaviorism.

Innate and Adaptive Components of Behavioral Systems

In bringing a multidimensional and multilevel extended evolutionary synthesis into clinical psychology, it is necessary to address both the innate and adaptive aspects of behavioral systems. This is powerfully true in clinical psychology, which is an historical science in one sense but a science of adaptive change in another.

It will be helpful to have an initial physical analogy for considering these issues. An excellent example is provided by the immune system.

The immune system is indubitably an evolutionary process that takes place during the lifetime of an organism. It is designed to produce roughly 100 million antibodies and to select for those capable of binding to infectious agents. However, while our antibodies are selected by consequences, many components of the immune system do not change during the lifetime of the organism. The evolving and non-evolving components of the immune system are referred to as the adaptive and innate components respectively. The terminology is somewhat misleading because the innate component is a highly adaptive product of genetic evolution and the mechanisms of antibody variation and selection are genetically innate. Also, the two components are not isolated from each other; the adaptive component extensively relies upon the innate component to attack and remove the infectious agents that are tagged by the antibodies. The word adaptive needs to be understood as adapting during the lifetime of the organism.

The psychological adaption of human beings is similar to the immune system, with both innate and adaptive components. The innate component is close to the vision of the first evolutionary psychologists, who emphasized the importance of domain-specific adaptations to specific problems of survival and reproduction in the genetically ancestral environment. The adaptive component of the behavioral system is close to the vision of CBT, behavior analysis, and other parts of the behavioral sciences that emphasize the open-ended nature of human behavioral change, at the level of both individuals and cultures. When evolutionary psychology was first formulated by Cosmides and Tooby (1992), these processes were largely excluded. Thinking of the behavioral system as like the immune system can help us see how it was a mistake to minimize them. By expanding our view of clinical psychology, it is possible to target processes that can change within the lifetime of the person, while also addressing those processes that do not do so.

Evolution as a Purposive Process

For evolution science to become relevant to an applied area such as clinical psychology, the question of purposive and conscious evolution needs to be confronted because clinical intervention is all about intentional change. We will deal first with the issue of purpose.

The claim that evolution does *not* have a direction, other than what the environment selects, became dogma as part of the Modern Synthesis. This made some sense given the knowledge and backdrop of the time, but it needs to be revised on the basis of current knowledge. It is necessary to do so if evolutionary science is to be used as a framework for clinical psychology, since by definition clinical methods are applied purposively and consciously.

The core idea of the Modern Synthesis was first established by Weissman (1893), who showed that inheritance occurred only through germ cells and that mutations were arbitrary with respect to what the environment selects. This was in direct contrast to the claims of Lamarck, who provided for a role for experience and thus purpose in evolution, a view to which Darwin also subscribed (Jablonka & Lamb, 2014).

Baldwin and others proposed that learning can nevertheless provide a direction to genetic evolution (Crispo, 2007). We have already addressed an example in the genetic evolution of lactose tolerance in adult humans. What became known as the Baldwin effect has a curious status in evolutionary thought. It was regarded as a major breakthrough at the time but did not become part of the Modern Synthesis, only receiving the attention that it deserves during recent decades (Crispo, 2007; Weber & Depew, 2003). The general concept is that “purposeless” evolution can result in “purposeful” organisms, whose behaviors feedback to influence evolution, making it “purposeful” to a degree. This can be true not only for behaviors but also for genetic processes such as mutation rates, requiring a modification of the Weissman doctrine that mutations are always arbitrary with respect to what the environment selects.

In various forms, that possibility is now an established fact. For example, mutation rates themselves are known to be regulated by environmental stressors. It is true that evolution originates in blind variation, but evolvability itself evolves, a key concept in the extended

evolutionary synthesis (Laland et al., 2015; Pigliucci, 2007). For example, when faced with challenging environments, organisms across a wide range of phyla increase the rates of mutation and decrease the degree of DNA repair (Galhardo, Hastings, & Rosenberg, 2007). It is not the literal “future” that is producing such changes: it is the species adaptation to “futures” experienced in the past. Those with more mechanisms of evolvability were more likely to survive. In that context, it is reasonable to ask “whether the collection of species we have with us today is not only the product of the survival of the fittest, but also that of the survival of the most evolvable?” (Wagner & Draghi, 2010, p. 381).

A good example of a behavioral process that show evolved evolvability is the role of extinction and exposure. When confronted by the repertoire narrowing effects of avoidance following trauma, clinical psychologists commonly use exposure to undermine easy access to escape and avoidance, so as to induce greater psychological variability from which more adaptive habits can be established (cf., Thompson, Twohig, & Luoma, in press).

Evolution as a Conscious Process

As evolutionary principles are deliberately applied to intentional change, evolution moves from purposive in a descriptive sense to conscious in a functional sense. Human cultural evolution clearly has a directed component in a more verbal or cognitive sense. To a degree, people explicitly identify a target of selection, orient variation around the target, and replicate the practices that take them toward their goals. This is a variation-selection-retention process that qualifies as Darwinian, even if the target of selection was consciously chosen.

That said, it is also important to appreciate our qualifier “to a degree”. To a large extent, human cultural evolution is not consciously directed but instead is the result of many unintended social experiments, a few that hang together while the others fall apart. The result is a kind of functional organization that no one designed and that works without anyone knowing how it works. Even conscious intentions have a way of turning into arbitrary variation when they collide with each other.

The important point is that the idea of consciously managing evolutionary processes is fully compatible with modern evolutionary thought. Indeed, in psychotherapy intentional change is the basis for intervention and training, along with positive social change at the level of groups and large populations. That task can be accomplished more readily if it is understood that consciousness too evolves.

Consciousness can be thought of simply as the ability to respond to oneself and the environment and the regularities within and between them (Hayes, 2019a). Defined that way, the story of evolution necessarily overlaps with the story of the evolution of consciousness, since the adaptive advantages of a sensitivity to context will likely lead to increasingly elaborate ways of responding to the external and internal environment and its regularities, selected by a better fit between action and its environment. For example, a life form that is better able to detect the presence of a predator is not only more “conscious” of the presence of a predator, it is more likely to avoid predation. These changes are not agentic, but over an

evolutionary time scale they are purposive and they help explain how and why multiple evolutionary dimensions interact.

Human symbolic learning carries this process forward another step. A crucial line is crossed as learned one-way relations (for example, object → name) leads to the derivation of a two-way street of symbolic meaning that can then be recombined into symbolic networks. Children who do not show such abilities do not develop normal human language (Devany, Hayes, & Nelson, 1986), and relational networks of this kind have not yet been shown to be reliably produced in non-humans (Hayes, Barnes-Holmes, & Roche, 2001).

When human symbolic relations expand from instances of bi-directional naming, into such learned relations as “before and after” or “better and worse” comparisons, it is possible to be influenced by regularities in the environment that are cognitively constructed, not directly experienced, and to link these to verbally constructed purposive change. Constructing a verbal rule for the form “if I do this then I will get that” is something even a pre-school child can understand. Human verbal problem solving involves an “if / then / better” relational network that alters present action so as to coordinate actions with a cognitively constructed future. Responding of this kind affords conscious control of behavior in a new way. Skinner argued that “. . . operant behavior is the very field of purpose and intention” (Skinner, 1974, p. 55) in the sense that all organisms that have evolved since the Cambrian period act “in order to” produce consequences in the future that have been produced in the past. Humans capable of symbolic language and thought, however, can respond on the basis of verbally constructed futures. Evolution science itself can enter into such cognitive networks, and when people consider their future and apply evolutionary scientific concepts to actions and policy choices to alter that it, were are entering in an area of conscious evolution in a deeper and more purposive sense that is more parallel to the role of clinical psychology in their clients’ lives. For example, human cognition can change the “selection criteria” for human behavioral and cultural evolution to mean concordance with cognitively available meaning and purpose and that very process can be driven by evolutionary science knowledge being applied recursively to human behavior.

A example in clinical psychology of the combination of greater conscious contact with the inner and outer environment, and it’s linkage to purposes change can be found in the exponential growth of mindfulness processes in evidence-based intervention on the one hand (Hayes, Follette, & Linehan, 2004) and the greater attention to values-based change on the other (LeJeune & Luoma, 2019). The combination of both of these sets of processes is particularly powerful in creating change. For example, in persons struggling with depression, mindfulness based intervention creates important benefits, but these effects are increased if they are then augmented by a focus on values-based behavior change (Kingston, Becker, Woeginger, & Ellett, in press).

Taking Stock

This history of ideas we have presented has been brief and has been focused on the features of an extended evolutionary synthesis that are necessary to see clinical psychology as a form

of evolutionary science. It has hopefully been sufficient for us to make the following take-home points:

- The history of ideas in both evolutionary biology and psychology is far from settled.
- The expansion of evolutionary science beyond genetic evolution makes it more relevant to academic and applied psychology than in the past.
- Clinical psychology is already asking evolutionarily sensible questions and it has much to gain by thinking of itself as an applied evolutionary science.
- Psychology has as much to *contribute* to the synthesis as it has to gain.
- Clinical psychology in particular can contribute because evolutionary inquiry requires, at its starting point, the study of the organism in relation to its environment. This is why field research is always the starting point for the study of nonhuman species and why laboratory research must be richly informed by field research. Clinical psychology is a kind of “field station” for mind and behavior. It makes sense that it should take the lead in helping to place psychology more broadly firmly under the umbrella of evolutionary science.

Human Distress from an Evolutionary Perspective

We turn now to a few examples of ways that evolutionary thinking informs our understanding of common clinical issues. Clinical psychologists often work with a biased segment of the human population: those who are sufficiently distressed to seek the help of an expert. A fully rounded evolutionary approach that applies to all people leads to a novel taxonomy of sources of distress with important implications for intervention options.

We use the word “distress” rather than “pathology” for a reason. The word “pathology” implies the presence of a disease or a breakdown of the mind and body similar to the breakdown of a machine such as an automobile. This framing narrows thinking about treatment options to eliminating the disease agent or fixing the breakdown in the same way as repairing an automobile. Ellis, Bianchi, Griskevicius, and Frankenhuus (2017) call this the *deficit model* and it is widespread in clinical psychology and the study of problem behaviors such as juvenile delinquency (Ellis, Boyce, Belsky, Bakermans-Kranenburg, & Van Ijzendoorn, 2011).

The word “distress” is broader and includes categories that do not qualify as pathological. Consider the following categories, which emerge naturally from a fully rounded evolutionary psychology but are obscured by the deficit model.

Adaptive Distress

In his 2019 book *Good Reasons for Bad Feelings*, Randolph Nesse points out that negative feelings such as pain are as important for our survival and reproduction as positive feelings such as pleasure. This point is obvious (at least in retrospect) for physical pain, which causes us to do sensible things such as withdraw our hand from a fire, but it may hold equally for other forms of distress such as anxiety or depressed mood. If someone experiences anxiety

or depressed mood, perhaps there is something about their lives worth being anxious and depressed about. To the extent that distress has an adaptive function it is important to consider the possibility that biomedical dampening of emotional distress can cause harm in some cases by preventing clients from attending to the environmental causes of their distress and the meaning of their emotional responses (Andrews et al., this issue). Seeking to remove emotional distress in some cases might be similar to “fixing” a car by removing its warning lights.

Aligning Evolutionary Processes with Normative Goals

Evolution doesn’t make everything nice. It frequently results in behaviors that benefit me but not you, us but not them, or benefits that are only short-term and not long-term. In other words, there is often a big difference between what counts as adaptive in the evolutionary sense of the word and what counts as adaptive for individuals, groups, and large-scale society in the normative sense of the word. The behaviors that humans desire in a normative sense can evolve in a Darwinian world, but only when special conditions are met. Aligning evolutionary processes with our normative goals must be an active process.

Consider the mental obstacles of fear of failure, or a desire to get one’s way at the expense of others. These are all normal psychological responses that at times can result in benefits, compared to alternative actions: the avoidance of failure perhaps, or advantage over one’s social competitors. It just so happens that these “successful” behaviors, however, can also lead to dysfunctional outcomes in a broader sense over a longer timeframe, such as an excessive and stressful focus on failure, or chronic relationship difficulties.

Using a venerable visual metaphor in evolutionary biology called an adaptive landscape, a person with mental health problems is often like someone standing on the top of a small hill, wishing to scale a higher peak, but feeling unable to do so because every step goes in a downward direction. As with a person needing to face withdrawal symptoms in order to walk out of a severe substance use disorder, therapy often consists of assisting the individual in taking those downward steps until he or she reaches the upward slope of the taller peak of a healthier way of living.

The most important general point is that even when a person is without notable psychological deficits, evolutionary processes can lead to outcomes that lead to distress for self and others. The solution is not to treat the individual as broken, but to provide a sense of direction to establish contextually wise variation, selection, and retention processes that lead to better outcomes.

Recognizing and Addressing Cases of Evolutionary Mismatch

In addition to forms of distress that are adaptive in the evolutionary sense of the word but mis-aligned with normative goals, there are forms of distress that are maladaptive in every sense of the word because of a mismatch between the current environment and the “environment of evolutionary adaptedness (EEA)”, to use a term coined by an early pioneer of evolutionary psychology, John Bowlby (1982). As an example from nature, when baby sea turtles hatch and dig their way to the surface of the beach, they are adapted to quickly make their way toward the sea, which is obviously adaptive (Tinbergen’s function question).

The mechanism that enables them to do this is an attraction toward light (Tinbergen's mechanism question), which provides a reliable cue, since reflected light from the moon and stars causes the sea to be lighter than the inland. Until the arrival of beach houses and street lamps. The interaction between an adaptation to an earlier environment and a changed environment results in a catastrophically maladaptive behavior—baby sea turtles heading inland rather than seaward. There are no psychological mechanisms built into the turtles by genetic evolution to cause them to correct their mistake. The only solution to the problem is subsequent evolution, resulting in adaptation to the changed environment (which in this case is unlikely to take place in time to prevent extinction), or human interventions, such as collecting the baby turtles or implementing a coastal lights out policy during hatching season (Hu, Hu, & Huang, 2018)..

As a human example, our skin pigmentation reflects a tradeoff between protection against the damaging effects of sunlight and using sunlight to manufacture compounds such as vitamin D. Genetic evolution resulted in permanently dark skin in regions that are permanently sunny and variably dark skin (the ability to tan) in regions that are variably sunny. Increased mobility and the cultural invention of indoor environments creates mismatches between our genetic adaptations and our current environments: dark-skinned people unable to manufacture enough vitamin D, light-skinned people insufficiently protected from the sunlight, and so on. Only subsequent genetic evolution or human interventions (clothing, tanning lotions, vitamin D supplements in the diet) can solve these problems.

Common behavioral health problems such as obesity or cardiovascular disease show these same processes. The modern human environment is so different from our ancestral environments that mismatches are all around us, including many that remain to be identified. Also, solutions to some mismatches can create other mismatches of their own. All things considered, agriculture was a cultural adaptation that allowed agricultural people to displace hunter-gatherers. But the agricultural diet was greatly inferior to the hunter-gatherer diet and dietary mismatches continue to the present such as in the over-consumption of sugar and salt. An entire class of dysfunctions are called “diseases of civilization” because they are more common in so called developed nations than less developed nations.

Schooling provides a simple behavioral example. In all human cultures, an enormous amount of learned information must be transmitted across generations. Yet, in hunter-gatherer and most traditional cultures, there is very little that resembles formal schooling. Instead, children spend most of their time in mixed age groups. Younger children want to be like the older children, older children want to be like the adults (it's the only game in town) and learning takes place through self-motivated practice and play. The same kind of play is proving to be important for social and intellectual development in addition to the transfer of knowledge (Ginsburg, 2007). Without anyone intending it, formal schooling and other aspects of modern life have severely disrupted this “natural” educational process. Children are segregated into single age groups and learn from adults rather than each other. Play is highly restricted and also highly scripted by adults when it takes place at all. The loneliness and isolation that can result could easily foster anxiety and depression (Gray, 2013).

Many forms of clinically relevant behavior have all of these earmarks of evolutionary mismatch. The very bi-directionality of human symbolic thinking, for example, likely evolved based on its capacity to further foster cooperation (Hayes & Sanford, 2014). If a speaker could emit a characteristic sound in the presence of an object, a listener might orient toward the object when later hearing that sound simply as an extension of theory of mind skills, joint attention, and social referencing – all skills that even preverbal human infants are relatively good at, presumably due to our high levels of adaptation to social cooperation (see Hayes & Sanford, 2014 for a review of that evidence). That simple act of a listener would considerably extend social cooperation, such as being able to request the provision of objects from a distance. Thus the “two-way street” of human symbols likely began as a social process aiding in within group cooperation and facilitating successful competition among bands or troops. As these symbolic processes became internalized and elaborated, however, they moved from facilitation of cooperation to being used in problem solving (Hayes et al., 2001). Once there it would be natural to apply these increasing verbal skills to the evaluation to one’s own behavior. Many of the processes that are known to be clinically toxic, such as experiential avoidance, cognitive entanglement, harmful forms of impression management, and the like, appear to be unhelpful uses of symbolic skills that evolved for other purposes. When combined with the new forms of technology, also produced by these skills, people can be overwhelmed with constant exposure to painful images, harsh social judgments, and difficult social comparisons. People did not evolve to live in such environments. The result is an epidemic of anxiety and depression in young people that shows up in the office of the clinical psychologist (for an extended review of this evidence, see Hayes, 2019b).

To summarize, many forms of distress are caused by a mismatch between adaptations to past environments malfunctioning in the current environment. A sophisticated knowledge of evolution is required to diagnose and address evolutionary mismatches.

Managing Evolutionary Processes

Once evolutionary theory is envisioned to encompass all variation-selection-retention processes and we appreciate that what counts as adaptive in the evolutionary sense of the word does not always correspond to our normative goals, then psychotherapy can be seen as working with the client to manage multi-dimensional and multi-level evolutionary processes wisely.

In some respects, clinical psychology has been doing this all along. Just as an effective parent knows how to manage learning and reinforcement processes, even if this knowledge was not acquired scientifically, so too effective clinical practitioners have been applied evolutionary scientists even when they were unaware of evolutionary principles. We will make this point by considering briefly a core list of key evolutionary concepts (Hayes, Monestès, & Wilson, 2017): variation, selection, retention, context, dimensions, and levels. In each area it is not difficult to show that these concepts have been central to clinical psychology from the beginning.

Variation

It is not by accident that psychopathology has been characterized by forms of rigidity: emotional, cognitive, attention, behavioral and so on. Without a healthy degree of flexibility it is impossible to learn how best to adapt and prosper within any given environment. Clients often enter into psychotherapy saying that they are “in a rut,” or “stuck.”

Experiences that lead to psychopathology tend to be those that produce narrow and rigid forms of adjustment, such as abuse, trauma, lack of social support, stigma, inconsistent punishment, or other forms of aversive control (Biglan, 2015). Evidence-based psychotherapy attempts to produce the healthy emotional, cognitive, and behavioral flexibility so as to foster growth when encountering the mental cul de sacs produced by such histories (Hayes & Hofmann, 2017). Most of these processes of change focused on by clinical psychology are readily thought of as forms of healthy variation, such as cognitive reappraisal, mindfulness, emotional openness, attentional flexibility, trust, curiosity and the like. Thus, the key focus of psychotherapy is often on the ability to change and to modify particular dimensions of psychological events.

Selection

Psychopathology often addresses the impact of the wrong selection criteria. Addictive drugs produce euphoric feelings but at the cost of contributions to family or work. Avoidance of embarrassment or social anxiety self-soothes, but at the cost of social relationships. Psychopathology is a kind of evolutionary adaptive peak: “psychopathology is an evolutionary process gone awry in a specific way: it prevents further positive development via normal evolutionary processes” (Hayes, Sanford, & Feeney, 2015, p. 224).

Psychotherapy explores new selection criteria with clients such as values, emotional connection, intimacy, social involvement. It generally does so both through symbolic processes, through the therapeutic relationship itself, and through helping the client modify his or her social environment. The client is asked to consider and to contact what life would be like if other important consequences were pursued, whether through the open ended questions of motivational interviewing, the values exploration of acceptance and commitment therapy, or the behavioral homework of CBT.

The focus on successful change in psychotherapy is thus a kind of evolutionary focus. The criteria for “success” is the joint goal of treatment, and biopsychosocial changes are evaluated on that incremental basis. Once a successful event has occurred, attention can shift to how it can be retained.

Retention

At the psychological level, retention includes both a within-individual component, linked to repetition, inclusion of actions in larger patterns, and positive contingent consequences, and a between-individual component, corresponding to social learning and cultural transmission. Psychotherapists increase the likelihood of retention through homework, client check ins, dairies, self-reports, in session rehearsals, the use of cues and prompts, goal-setting, exercises, apps, text messages, and a wide range of other methods. There is a “use it or lose

it” principle built into nearly every clinical method, as therapists focus on practice and the creation of larger behavioral patterns.

Context

All evolutionary analyses are context sensitive. It is context that determines whether a particular traits or action variant is adaptive and will be selected. No phenotypic features are always fitted to context, and since contexts change, none that are well suited are well suited now will be well suited forever.

That means that applied psychologists need to carefully consider whether psychological changes are likely to be supported in the context in which they occur. Declawing may be fine for a house cat but cruel for an outside cat, and in the same way behavioral repertoires have to be fitted to the goals and needs of individuals.

Many forms of clinical intervention teach forms of context sensitivity, such as mindfulness training, attentional training, or training in noticing or labeling emotions. Other interventions attempt to alter pathological forms of context sensitivity, such as the use of exposure with trauma patients.

Dimensions

Clinical psychologists are informed by models and theories that provide analysis of the particular psychological dimensions that may be relevant to a given case. One client may be dealing with cognitive errors, another with emotional suppression; one may be struggling with a lack of motivation, the other with a lack of behavioral follow through; sense of self and attentional processes are a common focus of clinical assessment and intervention.

Any analytic approach within clinical psychology deals with some, not all, of these dimensions of cognition, affect, attention, self, motivation and overt behavior. Selecting the right dimension to target is the job of case conceptualization, functional analysis, and diagnosis; and deciding how to produce healthy variation, and to select and retain contextually adaptive variants, is the topic of clinical intervention linked to functional diagnostic systems. For decades, psychologists have abdicated that responsibility to syndromal diagnosis, but a multidimensional evolutionary view provides an alternative strategy that is designed from the beginning to have treatment implications (Hofmann & Hayes, 2020).

One implication of a multidimensional approach is that traditional group comparison psychological research methods are not legitimate ways to track multidimensional change that an individual (Hayes, Hofmann et al., 2019; Hofmann, Curtiss, & Hayes, 2020). For that, an “idionomographic” approach is needed that begins with high-density longitudinal idiographic data that is set up to be scaled to nomothetic generalizations.

Levels

The concept of multilevel selection reminds clinicians to address psychological issues in the context of relationships, culture, work life, sexual practices, family patterns, and so on, just as it suggests that clinicians ask their about diet, exercise, and nutrition. Humans are social

primates and social support or nurturance is protective of psychological health, much as social isolation and disconnection is harmful to it (Biglan, 2015). Psychological dimensions evolve, but they do so nested within sociocultural and biophysiological levels of analysis (Wilson & Coan, this issue).

The balance between the individual and the group applies to every clinical topic. An “individual” is anything but an “individual” in a literal sense. An individual can be thought of as a large collection of behavioral patterns, developmental stages, aspects of personality, organ systems, neurobiological patterns, and so on. Even just physically an individual is composed of 37 trillion human cells and even more cells from other life forms (e.g., in the gut biome). Like nested Russian dolls, psychotherapists need to deal with different level of analysis. The consilience that evolutionary science provides makes that task more conceivable. For example, therapists may help establish greater internal cooperation by reining in the selfish domination of specific thoughts, feelings, and actions that demand more time and attention from clients than is beneficial as measured against their own life goals.

The Evolutionary Task of Clinical Psychology

The features of the evolutionary landscape we have been discussing can be organized into an extended evolutionary meta-model (EEMM) as is shown in Figure 1 (Hayes, Hofmann et al., 2019; Hayes, Hofmann, & Ciarrochi, 2020a, 2020b). The EEMM is “meta-model” in the sense that it summarizes issues of importance that any model of psychological assessment, diagnosis, and change will need to address from the point of view of a multi-dimensional, multi-level extended evolutionary synthesis. This meta-model provides a framework for various clinical psychological models to explore their interconnections in a way that fosters greater consilience a clinical psychology is viewed as a form of applied evolutionary science.

If Darwinian evolutionary concepts apply, any model of assessment, diagnosis, and intervention within clinical psychology will be dealing with adaptive and maladaptive forms of variation, and selective retention in context, as they bear of psychological dimensions (cognition, affect, attention, self, motivation and overt behavior) nested within biophysiological and social cultural levels of analysis.

We will return to this model at the end of this special issue as we apply it in particular to diagnoses linked to processes of change, but we present it here in part because it presents a framework for understanding the scope and interrelatedness of clinical psychology as an evolutionary science. “Consilience” does not simply mean that wings of clinical psychology can speak politely and meaningfully to each other using evolutionary science concepts and ideas. Consilience is not alone a matter of reducing needless conflict – it is a way of speaking about the integration of clinical psychology itself done in a way that properly connects it to other domains of scientific interest.

In that regard, the EEMM helps remind us that a complete account requires attention to Tinbergen’s four questions as applied to all of the dimensions and levels of human

functioning viewed as Darwinian domains, *and to their interrelationships*. Clinical psychology cannot be said to be complete without understanding how genes, epigenes, and neurobiological processes interact with psychological and social culture issues viewed as a dynamical system being modified by variation and selective retention in context (Crespi, this issue; Horn et al., this issue; Schiele et al., this issue). In a similar way, individual human lives need to be understood in the content of their involvement in dyads, small groups, and larger cultures (Biglan, et al., this issue; Kohrt, at al., this issue; Wilson & Coan, this issue) and the variation and selective retention processes that operate at that level. Research on psychopathology and psychological intervention needs to address psychological issues as a part of a larger network of evolutionary processes (e.g., Andrews et al., this issue) understood in a longitudinal and idiographic way (Hayes et al., this issue). Thus, evolutionary science is a foundation for clinical psychology, but it is also a goad, suggesting that new research, methodological, and analytic steps will be needed for clinical science to mature as a science and to think in a more dynamical way that simultaneously addresses multiple strands of an evolving system.

Clinical psychology has much to gain by thinking of its task as a matter of learning how to foster healthy variation, selection, and retention, in context, of the right dimensions at the right levels. As we have shown in the previous section, in some ways this is what the discipline has been doing all along. Evidence-based interventions have long been interested in fostering and retaining successful change in the biopsychosocial dimensions that fit the client's goals in the context of their situation, history, sociocultural context, and physiological needs. All of these practices and goals are sensible in light of multidimensional and multilevel evolutionary science – what evolutionary science does is to put them in good order, and to remove the needless barriers both within clinical psychology and intervention science as a discipline, and between this wing and the rest of the life sciences. Clinical psychology has unknowingly been a wing of applied evolutionary science all along. It is time for the discipline to own that link, and to step up to the challenges and opportunities it presents.

COI Statement

Dr. Hayes receives compensation for his work as a content expert from New Harbinger Publications. He also receives royalties and payments for his editorial work from various publishers.

Dr. Hofmann receives financial support from the Alexander von Humboldt Foundation (as part of the Humboldt Prize), NIH/NCCIH (R01AT007257), NIH/NIMH (R01MH099021, U01MH108168), and the James S. McDonnell Foundation 21st Century Science Initiative in Understanding Human Cognition - Special Initiative. He receives compensation for his work as editor from SpringerNature and the Association for Psychological Science, and as an advisor from the Palo Alto Health Sciences and for his work as a Subject Matter Expert from John Wiley & Sons, Inc. and SilverCloud Health, Inc. He also receives royalties and payments for his editorial work from various publishers.

David Sloan Wilson administers his research grants through the Evolution Institute (a 501 (c) 3 organization). As president of the EI, he does not include salary support in these grants to avoid the appearance of conflicts of interest. Likewise, he directs book royalties and speaking fees to the Evolution Institute. He currently has grant support from the Issachar Fund in the Templeton Religion Trust; the Ewing Marion Kauffman Foundation, the National Institute of Economics and Social Research; and the Templeton World Charity Foundation.

Authors Bios

Steven C. Hayes is Nevada Foundation Professor in the Behavior Analysis program at the Department of Psychology at the University of Nevada. An author of 46 books and nearly 650 scientific articles, his career has focused on an analysis of the nature of human language and cognition and the application of this to the understanding and alleviation of human suffering. He is the developer of Relational Frame Theory, an account of human higher cognition, and has guided its extension to Acceptance and Commitment Therapy (ACT), a popular evidence-based form of psychotherapy that uses mindfulness, acceptance, and values-based methods. Dr. Hayes has been President of Division 25 of the APA, of the American Association of Applied and Preventive Psychology, the Association for Behavioral and Cognitive Therapies, and the Association for Contextual Behavioral Science. He was the first Secretary-Treasurer of the Association for Psychological Science, which he helped form and has served a 5-year term on the National Advisory Council for Drug Abuse in the National Institutes of Health. In 1992 he was listed by the Institute for Scientific Information as the 30th “highest impact” psychologist in the world and Google Scholar data ranks him among the top ~1,350 most cited scholars in all areas of study, living and dead (www.webometrics.info/en/node/58). Dr. Hayes is a Fellow of the American Association for the Advancement of Science, in addition to several other scientific societies. His work has been recognized by several awards including the Exemplary Contributions to Basic Behavioral Research and Its Applications from Division 25 of APA, the Impact of Science on Application award from the Society for the Advancement of Behavior Analysis, and the Lifetime Achievement Award from the Association for Behavioral and Cognitive Therapy.

Stefan G. Hofmann, Ph.D. is Professor of Psychology at Boston University, where he is the Director of the Psychotherapy and Emotion Research Laboratory. He was born and raised in Germany and has been living in Boston, USA, since 1996. He has published widely as an author of more than 300 articles and 15 books. He is a Highly Cited Researcher by Thomson Reuters and Clarivate Analytics. His research focuses on the mechanism of treatment change, translating discoveries from neuroscience into clinical applications, emotion regulation, and cultural expressions of psychopathology, especially anxiety disorders. Because of this expertise, he served as an advisor to the DSM-5 Development Process and was a member of the DSM-5 Anxiety Disorder Sub-Work Group. He is the recipient of numerous awards, including the ABCT’s 2010 Outstanding Service Award, the Aaron T. Beck Award for Excellence in Contributions to CBT by Assumption College, and the Aaron T. Beck Award for Significant and Enduring Contributions to the Field of Cognitive Therapy by the Academy of Cognitive Therapy. He is a fellow of the American Psychological Association and the Association for Psychological Science. He has also been president of numerous national and international professional societies, including the Association for Behavioral and Cognitive Therapies (ABCT) and the International Association for Cognitive Therapy (IACP). He is presently editor-in-chief of Cognitive Therapy and Research and associate editor of Clinical Psychological Science. His research has been funded through generous research grants from the National Institutes of Health private foundations.

David Sloan Wilson is a SUNY Distinguished Professor at Binghamton. He is also President of the Evolution Institute and Editor-in-Chief of *Evolution: This View of Life*, an online general interest magazine. David is known for his work on multi-level selection and on the importance of an extended evolutionary synthesis that can carry evolutionary principles into human behavior change. His work expands the horizon of evolutionary thinking beyond genetic evolution to include all of the fast-paced changes taking place around us in the form of cultural evolution, and the development of prosocial groups, and within us as each individuals. He has been at the forefront of expanding evolutionary science into the study of economics, religion, spirituality, medicine, art and literature, small groups, and intentional change in human behavior. An author of a dozen books and scores of scientific articles, he is a leading voice for the relevance of an evolutionary perspective to everyday human affairs.

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Highlights

- There has been a historical breach between evolutionary science and clinical psychology
- The expansion of evolutionary science beyond genetic evolution makes it more relevant to applied psychology than in the past.
- A multi-dimensional and multi-level extended evolutionary synthesis that embraces conscious evolution can help bring consilience to clinical psychology as a field as it moves past the “protocols for syndromes” era
- Clinical psychology has as much to contribute to this synthesis as it has to gain, since learning, behavior, symbolic thought, and culture are centrally important to an extended evolutionary synthesis

Figure 1.
The Extended Evolutionary Meta-Model of processes of change in psychological intervention (Copyright Steven C. Hayes and Stefan G. Hofmann).