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Towards a Fully Rounded Selectionist Approach

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Evolution goes beyond genetic evolution. Individual learning and cultural change are evolutionary processes (Skinner, 1981). Behavior of individuals and of groups is selected by its outcomes during the lifetime of the species (Wilson & Sober, 1998) and is selected by its outcomes during an individual's or a group's lifetime (Simon, 2016). B.F. Skinner's key phrase *selection by consequences* summarizes the resemblances of evolutionary processes on different time scales that bring about the bodily structures and the actions of living organisms. To be alive is to behave (Baum, 2010). An organism connects to the environment through its activities. Its behavior, along with the organism's organic structures allowing for it, evolves through selection processes. This approach to studying behavior by analysis of the consequences, which select it during phylogeny and ontogeny, is logically consistent, has proven useful to solve practical problems (e.g. Cooper, Heron, & Heward, 2007), and has instigated further scientific inquiry (q.v. section *Behavioral Selection on Multiple Scales*). By treating behavior as a natural event whose occurrence can be explained by evolutionary theory, Skinner's three-level framework allows for a quantitative account of behavior omitting anti-scientific concepts like free will and agency (Baum, 1995b). Through its publication in a journal as renowned and as broad in topic as *Science,* "Selection by Consequences" (Skinner, 1981) has affected various areas of scientific thinking since its first publication 35 years ago (e.g. Wilson, Hayes, Biglan, & Embry, 2014).

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To accentuate the broad scope of the key phrase *selection by consequences* and to carve out the importance of readdressing this approach, this commentary, first, discusses the approaches' implications for the nature-nurture debate and, second, outlines two current developments, stimulated by Skinner's (1981) "Selection by Consequences".

Emending the "Nature versus Nurture" Fallacies

Skinner's (1981) effort to outline selection processes of behavior during phylogeny, as well as during ontogeny, has two main implications for the explanation, prediction and change of behavior. First, the explicit focus on innate *and* learned causes of behavior counteracts the widespread misconception of behaviorism as a philosophy science denying inborn behavioral dispositions. Second, by guiding the way to effective change of behavior during ontogeny, *selection by consequences* goes beyond accounting for challenging behavior based upon a (phylogenetically produced) mismatch between innate behavioral tendencies and current environments.

How "Selection by Consequences" Counteracts the Tabula Rasa Misconception. An important contribution of "Selec-

tion by Consequences" (Skinner, 1981) is the clarification that genetic evolution and the flexibility of human behavior are not contradictory. Evolution does not imply genetic determinism, which prohibits a capacity for change over short time intervals. On the contrary, by regarding the open-ended capacity for behavioral and cultural change as both a product of genetic evolution, and an evolutionary process in its own right, Skinner places the capability for short-term changes explicitly within the orbit of evolutionary theory (Wilson et al., 2014).

Behaviorism has been widely misunderstood as a philosophy of science arguing for a treatment of individuals as "blank slates" (c.f. e.g. Kappeler, 2011). The "blank slate" assumption holds that organisms are born without behavioral predispositions. They are said to be born like a white piece of paper upon which the organism's experience writes. The following quotation is representative of the common misconception of Skinner's position towards phylogenetic selection: "The most famous example of blank slate theory in psychology is called Behaviorism […] Skinner adheres to the notion of the blank slate with the findings of the Skinner Box. By rewarding and punishing rats based on their actions toward certain levers, he shaped their behavior. Skinner concludes that all behavior is explained through reinforcement patterns" (Haag, 2008, p. 113). Leading cognitive scientists such as Steven Pinker (e.g. 2003) still contribute to the spread of the misconception of behaviorism as denying the role of "nature" and ascribing all development to the effects of "nurture". "Selection by Consequences" (Skinner, 1981) unambiguously places the "blank slate" assumption in the realm of misconceptions about radical behaviorism.

The focus of Skinner's approach lies in an outline of the similarities between the selection of physical structures and the behavior of organisms (Skinner, 1957). Both occur during phylogeny, as well as during ontogeny. During phylogeny, only those bodily structures whose constraints allow for relatively[1] more adaptive behavior of the organism recur in future generations. The same is true for the behavior of organisms. Behavior that was more susceptible to environmental consequences outcompeted behavior that changed less as a function of events that were relevant for the organisms' relative fitness. During ontogeny, operant behavior changes as a function of its contingencies with events that have affected the organism's fitness during phylogeny.

Organisms' bodily structures also change as a function of environmental events during ontogeny. One example is genes that are activated or deactivated due to hormonal fluxes, which result from environmental changes. Another example is bodily deformities such as phocomelia. Phocomelia, characterized by a malformation of limbs, was found in more than 10 000 newborns in 46 countries whose mothers had used thalidomide during pregnancy in the 1950s-1960s (Bren, 2001). Those cases illustrate another important effect of Skinner's three-level selection approach: It cuts the nature-nurture debate down to size by showing the impossibility of ascribing an organism's behavior and structure to either one (may it be in its entirety or as a proportion).

Next to its advocacy of the possibility of behavioral change during an individual's lifetime, one of the foremost strengths of "Selection by Consequences" (Skinner, 1981) is its argument for inheritance of actions' direct sensitivity to their outcomes. The proposition that behavior is directly sensitive to its consequences allows for more parsimonious explanations than the postulation of inheritance of various behavioral tendencies. When aiming at an explanation of altruistic acts for example, the assumption of a selection of acts of various extensions

[1]The concept of relative fitness (Gillespie, 1977) holds that not absolute increases or decreases in reproduction of a behavioral pattern or a physical characteristic matter for the individual's fitness but that an activity pattern or bodily structure needs to lead to higher reproductive success than that of competitors. In biological evolution, relative fitness is calculated by dividing an organism's absolute fitness (defined as it's total number of surviving offspring) by the average number of offspring in a given population.

in complexity and time (Rachlin & Locey, 2011) relieves us from postulating a direct inheritance of a 'sense of resource allocation fairness' (Fehr & Fischbacher, 2003) or of altruistic tendencies occurring in individuals within successful groups (Wilson & Sober, 1998).

The Nature-Nurture Distinction's Implications for Solving Practical Problems. Evidently, the strength of the selection by consequences framework not only lies in its explanatory power, but also in its guidance toward interventions. Just as the directive use of natural selection allowed for breeding more effectively by refining selective reproduction of, for example, livestock, so did the operant framework prove successful in predicting and controlling dysfunctional behavior. As in nuclear physics or the discoveries leading to electricity, our knowledge of natural and operant selection processes runs the risk of misuse. Given the history of Social Darwinism and the misuse of punishment in treatments of behavioral disorders, we do well to encounter ostensible implications of a selectionist's view with skepticism. These actual perils and "slippery slope" threats, however, need to be balanced against the overall possible enhancements, which the selectionist framework allows for.

A consideration of conceivable drawbacks of Skinner's approach must carefully distinguish between the contingencies we implement and naturally occurring contingencies. The question "Is selection good or bad?" can only logically be answered regarding contingencies we implement. It is not consistent with an evaluation of naturally occurring contingencies in general. Skinner's (1981) outline of similarities between natural phylogenetic and operant selection makes clear that naturally occurring operant selection processes happening during ontogeny are neither good nor bad. Just like natural selection during phylogeny, they simply happen. The framework makes clear that we behave "for" what Skinner called "reinforcers," that is, environmental events that affect our fitness. We may evaluate what kind of events control behavior in natural or controlled settings, but disapproval or denial of control of behavior as a function of external events, would lead to an ascription of behavioral causes to non-deterministic, likely unobservable, happenings. This would annul the whole endeavor of a science that is to uncover lawful relationships between natural events. Only the postulate of experimentally testable relations between environmental events and the behavior of whole organisms (Rachlin, 1994) allows for the latter's prediction and control.

The recognition that selection operates during the lifetime of the species as well as of the individual, allows for building a science of change that can tackle individually and societally relevant behavioral problems (Skinner, 1953). Anthropologists have widely acknowledged one side of it, namely the workings of natural selection on today's behavioral challenges. The gist of a commonly advocated position is summarized in L. Cosmides' and J. Tooby's frequently cited statement "the key to understanding how the modern mind works is to realize that its circuits were not designed to solve the day-to-day problems of a modern American – they were designed to solve the day-to-day problems of our hunter-gatherer ancestors." (1997, p. 12). Indubitably, if the environment changes, a formerly fit innate response tendency may no longer favor the organism. It may indeed work against the survival or reproduction of the organism. Yet, selection of behavioral patterns during the lifetime of the species is not the only selection process at work.

On the one hand, examples of current maladaptive behavior that appear logical in the light of knowledge about former environments are to the theory of behavioral selection during phylogeny what fossils are to the theory of selection of bodily characteristics during phylogeny. Such observations support the part of our story of behavioral evolution that cannot fully be tested expe-

rimentally – more specifically, accounts of its workings during phylogeny. On the other hand, an understanding of today's psychology as maldaptation stemming from selection processes during Pleistocene, as put forwards by Cosmides and Tooby, is largely incomplete. After all, today's behavior is in many aspects adaptive to current environments. This is not only due to overlaps between characteristics of current environments and those during which our behavior was selected in the Pleistocene period, but also because anthropologists' focus on selection of behavior during phylogeny is only telling part of the story. Behavioral selection during ontogeny enables short-term adaptations that have made our everyday activities largely adaptive to recent changes in our environment such as the advent of information technology, transportation systems or workspaces in offices and industries. Thus, the acknowledgement of selection processes during both phylogeny and ontogeny allows us to go beyond recognizing today's behavioral challenges. By leading the way to an implementation of changes in current environments that select behavior during the individual's lifetime, operant selection can reduce the mismatch between behavioral tendencies selected in hunter-gatherer societies and today's environments. Consequently, an analysis of selection during phylogeny and ontogeny not only generates a more complete account of behavior but also a much more useful one, leading to more numerous practical implications.

Two Current Developments Stimulated by Selection by Consequences

The following paragraphs outline two present-day research lines embracing *selection by consequences*. The first, Baum's (2015) notion of multiscale selection is a behavior analytic theory tightly connected to Skinner's (1981) approach to analyze behavior on three levels (i.e. phylogeny, ontogeny, cultural evolution). The second, Wilson's (2015) argument for selection as a domain general – that is, cross-disciplinarily investigated – process, paves the way towards a fully rounded evolutionary understanding of the activities and physical structures of living beings and guides us towards effective policy making.

Behavioral Selection on Multiple Scales. Skinner's (1981) outline of selection on three levels incidentally builds upon the assumption of limited resources, limited space in ecological niches, limited numbers of mates, and limits on time an organism can spend behaving. Without constraints, there is no selection. The replicators during organisms' ontogeny are their activity patterns. They compete because the overall time that organisms[2] can spend behaving is limited to 24 hours a day. The observation that all activities take time and that they consequently compete because time is limited, is the central starting point of W.M. Baum's (1995a, 2013, 2015) further development of Skinner's *selection by consequences* framework.

Competing activities may lead to qualitatively different outcomes, which select organisms' future activities. These outcomes consist of events such as predators, mates, or food that have affected the relative fitness of the organisms' ancestors. Such Phylogenetically Important Events or those related to them enter into a feedback loop with an organism's behavior, by inducing activities on which they are contingent (Baum, 2012).

Another respect in which Baum's (1995a) multiscale view further developed Skinner's three-level analysis (1981), regards the number and kind of degrees on which selection is presumed to take place. Baum's framework does not only distinguish between selection processes on the phylogenetic, the ontogenetic, and the cultural level but also on multiple, not mutually exclusive time scales within ontogeny. Scales, as opposed

[2]In line with Darwin's view (cf. 1874, pp. 178-179), Skinner (1981) advocated that selection pressure can act on individual organisms as well as on groups.

to levels, are a continuous notion. Even within ontogeny, activities consist of nested behavioral patterns of differing complexity upon which consequences of differing temporal extension are contingent. Additionally, Baum's multiscale view of selection of behavior occurring due to differential correlations between activities and Phylogenetically Important Events consolidates the position of behavior analysis as part of biology – a position that Skinner's three-level selection approach set out for.

Inspiring a Reconciliation of Academic Disciplines under the Umbrella of Evolution. The biologist D.S. Wilson has lately started to advocate a "third wave of evolutionary thought" (2015), which is based on a rediscovery of Skinner's selection by consequences and a reflection on Skinner's warning that "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" (1981, p. 501). Wilson (2014) advocates evolution as a domain-general process, knowledge of which will give us a better understanding and more effective approach to the problems our society faces. Awareness of natural selection has already inspired economic thinking (e.g. R. Frank's "Darwin Economy", 2011), organizational management (e.g. S. Otto's "Evolutionary Management", 2007), health policies (cf. the vaccine debate, Browne, 2015) and plenty of other domains. Knowledge about operant selection has, among other things, led to the development of widely effective cognitive behavioral therapy (for effects on depression c.f. e.g. Jacobson et al., 1996), has benefited patients with communication handicaps (c.f. e.g. Sundberg & Michael, 2001), and has inspired legislation (cf. e.g. the American Executive Order "Using Behavioral Science Insights to Better Serve the American People", Obama, 2015).

By virtue of the common reliance on selection as a causal mode, Skinner's (1981) outline of selection processes during phylogeny and ontogeny makes the science of behavior part of biology and the life sciences. Tying the study of behavior directly to evolutionary theory, Skinner paved the way to a reconciliation of disciplines allowing for effective prediction and control of the behavior of organisms, a topic with tremendous theoretical and practical relevance as the disciplines develop.

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