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EDITORIAL

Ordinaries

Toward a Neo-Darwinian synthesis of economics

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Abstract
The *Ordinaries* column began in 2019 to promote a Neo-Darwinian synthesis of neoclassical and behavioral economics. This article places already-published, as well as upcoming, *Ordinaries* columns into a comprehensive framework for a new, biological economics. The goal remains to improve economics by utilizing natural science theory and methodologies.

Ordinary: "With no special or distinctive features; normal. Not interesting or exceptional; commonplace."

-Oxford English dictionary.

1 A natural science synthesis of economics

The goal of the *Ordinaries* column is to use genetic evolutionary theory and related natural science perspectives to improve economics. Currently, there is a schism within economics between neoclassical and behavioral schools. These divergent views fundamentally disagree about each axiom of the field. Neoclassical and behavioral economics do, however, share a common set of social science methodologies that are not connected to the natural sciences.

Biology offers a route to a neo-Darwinian synthesis in economics. The natural sciences utilize a variety of methodologies and approaches not found in either neoclassical or behavioral economics. The *Ordinaries* column is intended to help move economics toward a natural science foundation, with a long-term goal of reuniting and improving economics.

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To date, we have published six *Ordinaries* columns (Burnham & Phelan, 2019, 2020a, 2020b, 2020c, 2021a, 2021b) with the common goal to catalyze the integration of economics and the natural sciences.

> The *Ordinaries* column will interpret economic behavior from the perspective of evolutionary biology. From this view of life, the anomalies of behavioral economics will disappear into a coherent biological framework that incorporates elements of neoclassical maximization. - Burnham & Phelan, 2019

In this article, we review the mission of the *Ordinaries* column, summarize the published articles in the series, create a framework for the overall *Ordinaries* project, and describe future articles.

2 Economics without the natural sciences

Economics currently is divided into neoclassical and behavioral schools. These two competing perspectives disagree about the axioms of the field. Because the disagreement focuses on the axioms, even the most important conclusions of economics are unsettled.

Is free trade good? Yes, if neoclassical economic views of human nature are correct. On the other hand, if behavioral economic views of human nature are correct, the neoclassical 'proof' that free trade is good, no longer applies.

Assumptions about human nature are—and must be—the foundation of economics. The efficacy of the entire field rests upon these axioms describing human wants and choices. There is sharp conflict, however, regarding these assumptions. As such, economics is a field with an unstable foundation, and a pervasive lack of consensus across the most important issues.

The four axioms of economics cover attitudes towards goods, time, risk, and people. Table 1a summarizes the differing neoclassical and behavioral beliefs relating to these four core issues. Across all areas, neoclassical theory assumes optimality. Behavioral economics, in contrast, recognizes and documents deviations from canonical predictions of optimality, labeling the deviations "anomalies."

"An empirical result is anomalous if it is difficult to 'rationalize,' or if implausible assumptions are necessary to explain it within the [neoclassical] paradigm." (Thaler 1987, p. 198). See *Ordinaries 1* for a more complete description of the schism within economics over preferences for goods, time, risk and other people (Burnham & Phelan, 2019).

The disagreement between the neoclassical and behavior schools extends beyond attitudes toward goods, time, risk, and people. The anomalies of behavioral economics also give rise to problematic issues spanning a wide variety of additional topics. Let us consider three of those topics.

Decision making. Neoclassical economics assumes people make great decisions. Individuals choose the best feasible option, constrained by money and information. Behavioral economics, in contrast, argues that in a wide variety of situations people use non-optimal decision processes that produce suboptimal choices.

Table 1a Economics is lost without the natural sciences (Adapted from Burnham, 2016; Burnham & Phelan, 2019)

	Neoclassical economic view	**Behavioral economic view**	**Open questions**
Decision making	Optimal. People maximize utility.	Flawed. People often fail to maximize utility.	Why are people bad at decision-making? Is there a theory to help predict what sort of decisions will be particularly problematic?
Goods	People optimize by picking the best, feasible option.	People make inconsistent and flawed choices.	Why do people get pleasure from some destructive choices? Why do people dislike many behaviors that are constructive?
Risk	People make good, consistent decisions regarding risk.	People make inconsistent decisions regarding risk.	Why are people inconsistent in risky choices? Is there a theory to help predict human behavior in uncertain settings?
Time	People make good, consistent decisions involving multiple time periods.	People make inconsistent decisions involving multiple time periods.	Why are people inconsistent in intertemporal choices? Is there a theory to help predict human behavior in discounting settings?
Selfishness	Individuals care about themselves and derive no pleasure or pain from the lives of others, not even their own children.	Individuals are inconsistent in their attitudes toward other people. People are sometimes spiteful and at other times altruistic.	Why are people sometimes spiteful and sometimes altruistic? Is there a theory to predict people's attitudes toward others?
Self-improvement	None needed.	Nudges.	Is there a framework for self-improvement?
Road forward for economics	Journey is over. Behavior is optimal.	More anomalies, new 'behavioral' preferences, more nudges.	The first behavioral economic studies were conducted in the 1960s. Is there a way to speed up progress?

Self-improvement. Neoclassical economics assumes all decisions are optimal. Consequently, there is no need for individual self-improvement. Better outcomes are possible, in the neoclassical view, only with a larger opportunity set (i.e., more money) and better information. From the perspective of behavioral economics, conversely, people can be helped by advice. A famous set of behavioral interventions has been labelled nudges (Thaler & Sunstein, 2008).

Improving economics. From the perspective of neoclassical economics, the toolkit for understanding human behavior is complete. There is little work ahead

to improve economic theory and none to improve individual outcomes. People make optimal decisions about all aspects of life.

Within behavioral economics, on the other hand, at least three strands of ongoing research are relevant to improving these foundational axioms. First, a continued effort to document more 'anomalies'—divergences between actual human behavior and neoclassical predictions about behavior. Second, the creation of behavioral models that are better aligned with observed human behavior than neoclassical models. Third, the invention of new and more effective nudges for improving outcomes.

Despite having a clear path forward, behavioral economics suffers from having no underlying theory. Observations unambiguously reveal biases and heuristics. But why are people like this? Behavioral economics has no answer. And because behavioral economics is atheoretic, comprising a loose collection of empirically-derived, hard-to-summarize observations, it is difficult to use to predict behavior.

In summary, economics today is a divided field. The neoclassical view is that both economic theory and economic behavior are optimal. Behavioral economics has documented a variety of failures of neoclassical economics, but lacks a theoretical foundation and so provides few testable predictions of behavior (See Table 1a).

3 Natural science insights: *Ordinaries* 1–6

The *Ordinaries* columns present a natural science framework for understanding and predicting human behavior. Incorporating rich existing data, we illustrate the power of this approach for addressing and answering important questions in economics. Here we summarize each of the published articles and, in Table 1b, illuminate how the biological insights derived fit within our economics framework.

Ordinaries 1: Thomas Kuhn, Adam Smith, and Charles Darwin

Ordinaries 1 makes two main points. First, it places economics within Thomas Kuhn's framework for paradigm shifts in intellectual fields. Second, and relatedly, it notes that behavioral economics focuses only on a small subset of human behavior, and remains largely silent about some of the most important behavioral issues facing people and societies.

(a) Economics and scientific revolutions

Thomas Kuhn describes three phases in a scientific revolution (Kuhn, 2012). Phase one is a dominant paradigm that is incomplete. Phase two is the accumulation of "anomalies," observations that are inconsistent with the existing theory. Phase three is a new, better theory in which the prior theory and the anomalies are reconciled.

Economics fits well in the Kuhnian framework. Kuhn's Phase one is the incomplete neoclassical model of human behavior. Phase two consists of the identification and cataloging of anomalies by behavioral economics. Phase three is the yet-to-be-completed synthesis of neoclassical and behavioral economics.

(b) Behavioral economics is an insider's critique

Neoclassical economics assumes optimal behavior. Behavioral economics is devoted to documenting non-optimal choices. To a non-economist, glaring examples of non-optimal human behavior include suicide, drug addition, overspending, and lifestyle choices that hasten disease and premature death.

Peculiarly, behavioral economics focuses not on death, poverty, and addiction, but rather on seemingly unimportant issues such as "non-transitory preferences," and failure to adhere to the "independence of irrelevant alternatives."

The first anomalies column, written by Nobel Laureate Richard Thaler, discusses people's failure to solve a logical puzzle known as the Wason Selection task. Recall, a central goal of behavioral economics is to prove the neoclassical assumption of optimal choice is wrong.

Why pick the Wason Selection task instead of, for example, heroin addiction to explore whether humans make optimal choices? There are two explanations for the behavioral economic decision to focus on seemingly inconsequential behaviors.

First, the behavioral economic critique is an insider's research program. Behavioral economics uses the same terminology and methodology as neoclassical economics. Within both neoclassical and behavioral economics, the goal of behavior is happiness. As such, dying tomorrow from heroin could be 'optimal' if the pleasure received today is sufficiently large.

Second, economists are generally well-trained in math and less knowledgeable about the natural sciences. Progress toward biological economics depends on economists getting better at the natural sciences. Heroin "hijacks" existing neural pathways in people, causing them to experience the exact euphoric brain states that occur during typical situations of pleasure and happiness.

It is very hard, we believe, to understand the neurochemistry of drugs and the behavioral choices associated with drug addiction without some significant understanding of chemistry and biology. Thus, when given the choice between evaluating the causes, consequences, and optimality of heroin addiction or the performance on the Wason Selection task, behavioral economics stays firmly in the social sciences.

Ordinaries 2: **Strangers in a strange land: mismatch and economics**

Genetic mismatch is the primary explanation for the anomalies of behavioral economics. Such mismatch is also the cause of a broad and widely-observed range of self-destructive human behaviors, including drug addiction, unhealthful lifestyles, and failures to save enough money.

Natural selection favors the evolution of preferences and behaviors that induce individuals to maximize biological fitness–that is, their reproductive output relative

to other individuals. In populations living in the natural setting to which they are adapted, individuals make choices and behave in ways that do just that.

Mismatch occurs when populations–such as industrialized humans–live in an alien environment, different in systematic ways from the ancestral environment. In these situations, genes—including those influencing behavioral decisions—can become "out of sync" with the environment. This is most likely to occur when the environment changes rapidly.

Evolution adapts populations to their environment, but this is a slow process that can take dozens or even tens of thousands of generations. Thus, it is possible for genes to reflect prior, ancestral environments. When this occurs, human behaviors may no longer result in maximization of relative reproductive success.

Genetic mismatch explains the anomalies of behavioral economics. We make bad decisions in novel environments. We like some novel products such as heroin that are bad for us and dislike some inventions like colonoscopies that are good for us.

The idea that biology can cause behavioral mistakes may be counter-intuitive. Shouldn't evolution favor success in the competitive 'survival of the fittest?' Yes, humans are the products of natural selection, and natural selection favors behaviors that maximize reproductive success. Thus, natural selection favors neoclassical type optimization in which organism behavior maximizes outcome (though the feature optimized differs).

Mismatch explains more than the anomalies of behavioral economics. Recall that behavioral anomalies do not include suicide, addictions of various kinds, poor diet, and failures to be physically active. Genetic mismatch is a primary cause of these issues.

Consider drug addiction. Fentanyl was created in 1959. Humans and rats both derive pleasure from fentanyl because the chemical fits into nearly identical receptors in both species. Those receptors evolved to produce pleasure in response to finding food, mating and other fitness-increasing behaviors.

Because fentanyl binds to opioid receptors, it causes the release of dopamine, producing pleasure even though the organism has not engaged in any fitness-increasing behavior.

The brain machinery that is mistakenly stimulated by fentanyl has existed for tens of millions of years, functioning well in a fentanyl-free world. Because of fentanyl's creation—within the past 3–4 human generations, the blink of an evolutionary eye—our brain's pleasure center is mismatched to our environment, which now includes fentanyl.

A biologist is not surprised by anomalous behavior in a new setting. Quite to the contrary, it would be remarkable if humans did not demonstrate a preference for fentanyl. Similarly, it would be remarkable if using fentanyl led to optimal behavior (by any definition of optimal).

Mismatch is central to understanding human behavior in a wide variety of areas.

Ordinaries 3: Happiness is a genetic incentive system

Happiness is a genetic incentive system, shaped by natural selection, to induce evolutionarily successful behaviors. Economics assumes that people seek to

'maximize utility,' or some other description of happiness. Happiness is thus the foundation of economics.

Natural selection, however, favors maximization of reproductive success, not happiness. In fact, pleasure and pain are genetic creations evolved to induce behaviors that increase an individual's reproductive output.

The proximate cause of human happiness is the release of dopamine in the brain's pleasure center. The ultimate cause of this happiness system lies in its evolutionary function. Natural selection created dopamine and the pleasure-based learning system to influence behavior so as to increase genetic replication, not to increase happiness.

Ordinaries 4: Surviving desire: the causes and cures of self-control issues

Self-control is the internal battle between competing behaviors. Often this conflict takes the form of doing what we want to do versus what we ought to do. Pizza or grilled wild fish? Spend our paycheck or save? Exercise or watch TV?

Ordinaries 4 creates a "taxonomy of self-control." While limited to four distinct strategies, the specific applications are unlimited and comprehensive.

- *Will power* is a version of 'just say no' to temptation. Most people try this approach first. In cases of failure, other strategies are required.
- *Innovation* is the creation of new options that are both good for us and feel good.
- *Mast-strapping* is a method of avoiding temptation by reducing options.
- *Dopamine modulation* is the taking of steps to alter the pleasure we receive from competing choices.

The taxonomy of self-control rests on a biological foundation. Self-control can be viewed as conflict between the brain's executive function in the prefrontal cortex and dopamine release in the brain's pleasure center. Will power is the prefrontal cortex winning in the fight for control. Innovation, mast-strapping, and dopamine modulation all change behavior by strategically altering the landscape to remove or reduce internal conflict.

Ordinaries 5: Intertemporal choice: biology informs economic theories of discounting

Discounting describes decisions that involve more than one time period. As with other issues, neoclassical and behavioral economics disagree on the manner in which humans discount.

Neoclassical models assume people make good, consistent discounting decisions. In sharp contrast, behavioral models argue that people make bad, inconsistent discounting decisions. Behavioral economics frequently assumes that people place too much emphasis on short-term payoffs.

Natural selection favors consistent and appropriate discounting. Animals exhibit tremendous patience in natural settings and there is no evidence of animals in their natural habitats being too short-term oriented.

Human neural structures for discounting share essential structures with non-human animals. It is only when animals, including humans, are placed in novel environments that the resulting behavior can be suboptimal by appearing to be too impatient or too patient. While we can impose a discounting framework on choices, discounting is neither an accurate description of internal mental states, nor of human behavior.

Genetic mismatch is a central source of discounting anomalies documented by behavioral economics. Because humans live in a novel environment, people do not make appropriate intertemporal decisions without training and experience.

Humans in novel environments are not exponential discounters as assumed by neoclassical economics. Equally wrong is the behavioral economic view that humans are hyperbolic discounters or always suffer from excessive impatience.

***Ordinaries 6*: Big Macs & Economics: why we love foods that kill us**

There are two types of behavioral puzzles. Why do we get pleasure from behaviors that are bad for us? And, why do we get displeasure from behaviors that are good for us? For example, humans get pleasure from life-shortening consumption of *trans* fats and heroin, and displeasure from life-extending colonoscopies and vaccines. Why?

Big Macs are an iconic example of a product that tastes good to many people yet shortens life. *Ordinaries 6* examines, in detail, the biological source and mechanisms that create pleasure from the consumption of dietary fat.

Our taste for dietary fat is a genetic adaptation. Among our ancestors, those who ate more fat, had longer lives and more babies. Our world has changed the amount, types, and relative cost of food varieties. In our modern environment, people who eat more fat, particularly 'bad' fat, have shorter lives.

Genetic mismatch is the answer to the puzzle of why we like foods that kill us.

4 The road ahead to biological economics

Biological economics has the ability to synthesize behavioral and neoclassical economics into a single, coherent field. Natural selection favors non-conscious optimization, thus supporting the neoclassical view of humans as maximizers. But—perhaps paradoxically—while supporting neoclassical optimization the natural sciences also predict the anomalies of behavioral economics.

Behavior is produced by specific physiological machinery that is flexible and contingent on the environment. In specific settings, such as modern industrial environments, this biological machinery produces anomalous and sometimes destructive behavior.

Biological economics thereby represents Phase three in the Kuhnian framework for a paradigm shift. When a scientific revolution progresses, the anomalies of Phase two are subsumed into a new, better framework. In Kuhn's words, neoclassical and behavioral economics will reconcile "only when the paradigm theory has been adjusted so that the anomalous has become the expected." (Kuhn, 2012) p. 53.

Biological economics supports neoclassical non-conscious optimization (Phase one in the Kuhnian framework) and predicts the anomalies of behavioral economics (Phase two in the Kuhnian framework).

The published *Ordinaries* articles describe three major themes underlying the new biological economic paradigm. After summarizing these three themes, we fill in Table 1b with some answers to the important open questions in economics that are identified in Table 1a. The same table will be more fully completed at the end of the Ordinaries articles in 2022 or 2023.

Theme one: Happiness is a genetic tool evolved to induce biological success. Over evolutionary time, natural selection favors preferences that create pleasure from behaviors that lead to genetic replication.

In *Ordinaries 3*, we make an analogy to dog-racing where the dogs chase an ever-receding goal in the form of an artificial rabbit. The dogs believe that they will be happy if they catch the rabbit, not thinking about the bigger picture, in which the race track has been designed for another purpose.

Similarly, humans pursue behaviors that produce pleasure, largely unaware (at least until Darwin) that pleasure is an ephemeral incentive, a goal naturally-selected to produce genetic replication.

"Maximize utility" is an undergraduate summary of economics. Because utility is central to the field, it may seem that economics is fatally flawed because of its ignorance of the actual nature and function of utility to humans.

For animals in equilibrium with their environment, the utility perspective is actually sufficient. If one observes a wild animal in its natural setting, the economists' "maximize utility" assumption produces the same predictions as the biologists' maximize genetic success.

Natural selection favors the evolution of preferences so that maximizing utility leads to genetic replication. For a population in equilibrium with its environment, it is perfectly fine to assume that individuals simply maximize utility. The actual, but subconscious, genetic goal of maximizing replication via reproductive success can remain off-stage and unaddressed in the case of equilibrium.

Theme two: Humans exist in a situation of genetic mismatch because we currently live in a world that is very different from the world of our ancestors, to which we are evolutionarily adapted. We repeatedly visit food in the *Ordinaries* article because it is a salient example of mismatch and a nearly universal behavioral challenge for modern humans.

Ancestral humans were hungry and perpetually faced starvation. Eating food produces joy (by causing the release of dopamine and other brain chemicals) because genes benefit when people take actions (often risky) to obtain energy in the form of food. Modern humans have ancestral genes for generating the highly-motivating sensation of hunger, but live in a different world. To the contrary, many humans today face the evolutionarily-novel problem of too much food. Obesity and other dietary problems are caused by genetic mismatch.

Genetic mismatch extends to all aspects of industrialized life. In *Ordinaries 2* we discuss novel features of modern life including motorcycles and motorcycle helmets, heroin, dentistry, vaccines, and more. In each case, novel inventions and circumstances produce genetic mismatch and lead to non-optimal behaviors.

Humans live in an alien environment. What is the prediction for behavior in an alien environment? The answer is that animals in novel environments (e.g., fish out of water) maximize neither happiness nor reproductive success (see Burnham, 2016 for a fuller explanation).

A caricature of genetic influence on traits is the notion of "hard-wired" behavior. Some people conflate the argument that genes can have an impact on human behavior with the idea that any genetic influence necessarily dictates the production of lumbering genetic robots, devoid of free will.

Genetic influence does not imply hard-wired behavior. Consider that virtually no Giant Pandas in captivity ever mate. Only with the assistance of artificial insemination do captive Giant Pandas produce offspring. If any behavior were hard-wired to facilitate genetic replication, it would be reproduction. In fact, many species are extremely sensitive to the environment and behavior is highly flexible.

Mismatch is perhaps the most important issue for economics. If humans lived without mismatch, it would be straightforward and productive to predict that behavior would maximize both happiness and reproduction.

Neoclassical economics describes human behavior in conditions without genetic mismatch. However, there are no humans in the world today who are not mismatched to their environment. As a consequence, neoclassical economics is a poor predictor of modern human behavior. Because empirical observation is central to the approach, behavioral economics is more consistent with human behavior. The anomalous human behaviors it catalogs are caused by genetic mismatch.

Theme three: The natural sciences have enormous stores of knowledge relevant to economic behavior, and deep understanding of the nature of preferences forged by natural selection. Some time ago, we gave a talk on biological economics at the Harvard Business School. A famous, tenured economist, stated, "Let us assume you are correct. Humans were forged in an ancestral environment very different from the modern world. Furthermore, the issues that puzzle economists arise from genetic solutions to ancestral problems. Even if it were true, your biological agenda would require knowledge of the ancestral human world." (Yes.)

Restating this comment, if biological economics were true, economists would need to know a lot about the ancestral environment. Fortunately for economics, many other disciplines have been working for centuries to understand that ancestral world! Their rich research literatures document it in great detail. For example, for ancestral humans we know group size, types of tools, brain capacity, food sources, types of shelter, and myriad other attributes.

Adding irony to the tenured economist's comments is the fact that this specific person had just accepted the provost's job at Harvard, overseeing all departments, including anthropology, archeology, psychology, and organismic and evolutionary biology. These are exactly the fields that know the answers to the issues he noted as crucial to understanding the ancestral environment.

The *Ordinaries* column is designed to catalyze the building of a natural science foundation for economics. The *Ordinaries* articles (already-published and forthcoming) utilize evolutionary theory and natural science discoveries and methodologies to illuminate those issues that divide economics.

Table 1b Biological insights on the road to a Neo-Darwinian economics synthesis

	Neoclassical economic view	**Behavioral economic view**	**Biological Economics**
Decision making	Optimal. People maximize utility.	Flawed. People often fail to maximize utility.	Utility is a genetic incentive system selected to induce reproductive success. Genetic mismatch causes people to make decisions that maximize neither happiness nor reproductive success (*Ordinaries 3*).
Goods	People optimize by picking the best, feasible option.	People make inconsistent and flawed choices.	People live in evolutionary novel environments. Our battle with our own tastes is caused by genetic mismatch (*Ordinaries 1*, *2* & *6*).
Risk	People make good, consistent decisions regarding risk.	People make inconsistent decisions regarding risk.	Natural selection favors optimal risk-taking. Genetic mismatch produces the anomalies documented by behavioral economics (*Ordinaries 2* & future articles).
Time	People make good, consistent decisions involving multiple time periods.	People make inconsistent decisions involving multiple time periods.	Natural selection favors optimal discounting. Genetic mismatch produces the anomalies documented by behavioral economics (*Ordinaries 2* & *3*).
Selfishness	Individuals care about themselves and derive no pleasure or pain from the lives of others, not even their own children.	Individuals are inconsistent in their attitudes toward other people. People are sometimes spiteful and at other times altruistic.	Natural selection favors maximizing genetic success. People value relatives according to the "coefficient of relatedness." Spite and altruism are tools to further self-interest (*Ordinaries 2* and future articles).
Self-improvement	None needed.	Nudges.	There are four strategies for self-improvement: will power, innovation, mast strapping, & dopamine modulation (*Ordinaries 4*).
Road forward for economics	Journey is over. Behavior is optimal.	More anomalies, new 'behavioral' preferences, more nudges.	Integration with natural sciences theory and methodology (*Ordinaries 1, 2, 3, 4, 5, 6*, and future articles).

The neo-Darwinian synthesis of economics will take decades or more. Other scientific paradigm shifts, such as the Copernican Revolution took a similarly long time. The rate of change is constrained by a number of factors including the need for outdated thinkers to leave the positions of power. In the case of

economics, the education of economists would need to shift from math toward the natural sciences. This sociologic change has not begun and could take generations.

Although the path is long—and will extend beyond our lives—we take these steps to promote biological economics. We envisage somewhere between three and six additional *Ordinaries* articles to be published in 2022–2023. These future articles will cover risk and altruism, as well as a concluding article (see Table 1b).

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