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Feeding the behavioral revolution: Contributions of behavior analysis to nudging and vice versa

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Abstract
One of the long-standing disciplines specialized in behavioral prediction and change - but underrepresented in research on "nudging" - is behavior analysis. This article aims at feeding the behavioral revolution currently underway, by debating the relation between the relatively recent nudging concept and its underlying behavioral principles from a behavior analytic viewpoint. Our aim is to contribute towards a more comprehensive nudging theory and technology, connecting two traditionally separate fields. First, we define nudging from a behavioral analytic standpoint, integrating the traditional definitions in behavioral economics with behavior analysis. Then, we discuss more than 40-year old behavior analytic research on nudging in a controlled setting, investigating basic learning principles that make nudges effective in the laboratory. Closer cooperation between behavior analysists and other nudging theorists, for which this paper lays the groundwork, will enable scaling-up and sustaining such behavioral change at the policy level. By outlining the similarities and differences between nudging and behavior analysis, we investigate how both approaches can benefit from each other. In particular, nudging and traditional behavior analysis diverge in their respective focus on the antecedents and consequences of behavior. Our framework, viewing nudges as a subgroup of all environmental events that may influence behavior, has the potential to improve the choice architecture investigated by both disciplines. Finally, we submit that ethical considerations need to be addressed whenever there is (soft) behavioral control involved, and suggest additional avenues of research to further enhance behavioral scientific research.

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Keywords
choice architecture — nudge, contingencies — behavior analysis — antecedents and consequences — important events

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Introduction

In recent years, there has been an exponentially increasing interest in the concept of *nudging*, both within academic milieus and among the public interested in decision-making and choice behavior. Richard Thaler and Cass Sunstein, respectively the most recent (2017) Nobel Memorial Prize awardee in Economics, and the Robert Walmsley University Professor at Harvard Law School, share the merit of first defining a *nudge*. Moreover, they systematized nudging research thanks to a number of scientific articles (among others, Benartzi, Peleg, and Thaler, 2007; Sunstein, 2014a, 2015, 2017; Sunstein, Reisch, and Rauber, 2017; Thaler and Benartzi, 2004), and beyond the academic field with their book *Nudge: Improving decisions about health, wealth, and happiness* (Thaler and Sunstein, 2008).

In addition to attracting a broad audience of academic and non-academic readers, the authors also enhanced awareness of empirical methodologies among public servants and governmental authorities. This represents the domain of behavioral insights, which "refers to the application of behavioural economics or the 'nudge theory" (OECD, 2017, p. 401), electively through policies and regulations. The United States, United Kingdom, Denmark, Australia and the European Commission are among the most active outposts capitalizing on behavioral insights: not only did they feature the establishment of the first behavioral insights or nudge units; they also contributed to the development of the conceptual empirical framework of nudging. Upscaling and embedding behaviorally informed approaches in sustainable policymaking cycles are the next frontiers for linking nudging theory and practice in multidisciplinary academic and policymaking environments.

Understanding behavior and, thus, the laws underpinning its modification are the core of nudging. Nevertheless, the contributions to this approach have been attributed to behavioral economics, political sciences and cognitive psychology. Contributions from the discipline of behavior analysis –defined as "a natural science that seeks to understand the behavior of individuals" (ABAI, 2015)– have gone largely unnoticed and are seldom acknowledged in the broader behavioral scientific approach.

This article outlines the contribution of behavior analysis

towards the formulation and further refinement of nudging. We call for closer integration and increasing the contact between nudging and behavior analysis to both improve nudging interventions and behavior analytic theory and experiments, in the lab as well as in the field.

Defining a nudge: choice architecture as contingencies

One of the consequences of the increased interest in nudge applications has been incremented effort towards its definition. Depending on the framework and scope of the proponent, more weight has been placed on the cognitive functioning of nudges (Hansen, 2016), the feedback it provides access to (Rachlin, 2015), their social utility (Lunn, 2014), the corrective action they exert on our flaws (Hausman and Welch, 2010), or on their embedment in the environmental design (Thaler and Sunstein, 2008).

A thorough analysis of the evolution of definitions of *nudges* reaches beyond the scope of this article. Nevertheless, we find a close correspondence between the first definition of a nudge by Thaler and Sunstein and an understanding of nudging from a behavior analytic perspective. A *nudge* has been originally defined as "any aspect of the choice architecture that alters behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (Thaler and Sunstein, 2008, p. 6).

The term *contingency* is the behavior analytic counterpart to *choice architecture*. In behavior analytic jargon, *contingency* is a technical term denoting the functional relationship between the desired choice behavior and its context, i.e. the architecture of the environment. Even though *contingency* and *choice architecture* are not always synonyms, throughout this article, we use the two terms interchangeably to emphasize their common properties. At the same time, we call for distinguishing between natural and artificial contingencies, which correspond to the absence and presence of a choice architect in Thaler and Sunstein's original definition above. In the next section, we elaborate on the concept of contingencies by providing a primer of behavior analytic thinking to ease the reader into understanding the points of contact between behavior analysis and nudge theory.

Behavior analysis in relation to nudging

The historical starting point of behavior analysis as a scientific discipline is usually dated back to 1913, when Watson published *Psychology as the behaviorist sees it*. Today, behavior analysis is most commonly defined as the science of behavior consisting of experimental, applied and conceptual research. Roughly said, behavior analysis aims at illuminating why we do what we do and to what extent behavior is predictable and may be influenced. In particular, the subject matter of behavior analysis is to outline the relationship between behavior and certain aspects of the surrounding environment, which Sunstein (2014b) calls *choice architecture* and which behavior analysts call *contingencies* between environmental events and behavior.

Both nudge theory and behavior analysis operate from the same starting point: the ubiquitous influence on behavior of environmental events. A *neutral* architecture of choice is hardly possible and even a randomly designed environment affects choices one way or another (Thaler, Sunstein, and Balz, 2014). Thus, recognizing that environmental effects on behavior are unavoidable, an almost rhetorical question arises: Why not channel this influence? Even before a nudging intervention –say, placing the vegetables so they are more easily accessible than the meat in a grocery store (Lindström, 2015)– both the vegetables and the meat necessarily have to have one position or another in the store. If we do not place the vegetables first, the meat comes first –the position of which will influence behavior, too. The same may be said about the size of plates available at buffets: smaller plates nudge less food waste, but larger plates also nudge more food waste (Kallbekken and Sælen, 2013). Not only does our planned change in choice architecture influence choice, but naturally occurring choice architecture does so, too; and this is not necessarily a bad thing. As Sunstein (2014b) puts it:

> Every hour of every day, choices are implicitly made for us, by both private and public institutions, and we are both better off and more autonomous as a result. If we had to make all decisions that are relevant to us, without the assistance of helpful choice architecture, we would be far less free. In a literal sense, choice architecture enables us to be free. (pp. 130-131)

The communalities of the preposition of ubiquitous choice, and the aim of analysis and influence of choice architecture, suggest that nudging and behavior analysis have more in common than the few documented mutual references in their respective literatures imply[1].

Behavior analysis is the study of how individuals' behavior adapts to the individuals' environment during their lifetime. We are always surrounded by an environment; however, not all environmental changes affect our behavior. Throughout this paper, we call all aspects of the environment that do influence behavior *important events* (Baum, 2012; Shahan, 2017). These events, which have the power to influence our behavior today, may have gained that power either in the history of our species or during our own lifetime. Those of our ancestors, whose behavior did not adjust to maximizing opportunities to eat, to mate or to increase safety, left fewer offspring than ancestors whose behavior was affected by events that change access to food, mates or safety. Over generations, the affectability of behavior by events such as changes in the availability of food or mates became naturally selected and, thus,

[1] An OVID PsychINFO database interrogation with the following search criterion produced 4 results: (nudg* and behavior+analy*).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests measures].

genetically coded. Other important events gain their power to change behavior during our lifetime after we have experienced that these events co-vary with the availability of the events, which became effective during our species' history. After we have experienced that money co-varies with resources, money can affect our behavior (see eg. Baum, 2012, 2013, 2016, 2017a, 2017b; Baum and Davison, 2014 for more detailed discussion of these events).

For the current discussion of nudging as an example of a procedure that changes behavior during our lifetime, it is less relevant if a particular event has gained its power to influence our behavior during the history of our species or during our personal history. The concept of important events in the environment, however, is central to understanding to relation between behavior analysis and nudging. (Effective) nudges are a subgroup of all possible important environmental events. This subgroup is defined by programmed events that precede behavior that do not make alternative choices impossible.

The evolutionary framework of behavior analysis presupposes that humans and certain animals not only have commonalities in the arrangement of, for example, their skeleton, but also in the arrangement of their behavior. An experimental design frequently used to investigate the effects of choice architecture on humans and non-human behavior are so-called smaller-sooner/larger-later designs. In the following section, we discuss a classic experiment that behavior analysts conduced to test the effect of what we may call *nudging the choices of pigeons*.

Behavior analytic research on "soft" behavior control

Rachlin and Green (1972) published a smaller-sooner (SS) / larger-later (LL) study, in which they exposed food-deprived pigeons to a choice between A) immediate access of food for 2 seconds (s) and then a blackout of 6s (the SS option), and B) a blackout of 4s and then twice as long access to food (4s, the LL option). The pigeons chose almost exclusively the SS option – until Rachlin and Green changed the choice architecture to what satisfies Sunstein's (2014b) definition of a nudge. They added a 10s wait to both options, now giving the pigeons a choice between A) waiting 10 seconds and then choosing again between 2s of immediate food or an additional 4s wait followed by 4s of food. B) pigeons could chose a 14s wait followed by 4 seconds of food with no "opt-out" option to the "temptation" alternative, once this 14s "commitment" path to LL (4s of food) was chosen. Pigeons chose the commitment option B) about 55% of the time. When having chosen the "opt-out remaining" alternative A, however, pigeons never waited for LL at their second choice point but always went for the immediate, smaller amount of food.

Rachlin and Green's original choice architecture led the pigeons into temptation. When Rachlin and Green adjusted the pigeons' environment, they led them into commitment. They softly controlled, or nudged, the pigeons' behavior, keeping the "temptation" alternative available. Rachlin and Green manipulated means, not ends (as they would have done had they added punishment to the SS choice). The added cost (waiting), relative to the ultimate choice consequence (duration of food access), was small. In this forty-five years old experiment, Rachlin and Green acted as a government "softly" controlling their pigeon-citizens' behavior for their own good (Rachlin, 2015). Similarly designed experiments with human participants have abounded ever since the introduction of the SS-LL design (e.g. Solnick, Kannenberg, Eckerman, and Waller, 1980). Such controlled experiments with human and non-human subjects illuminate the basic learning principles that make nudges effective.

Antecedents and consequences in choice architecture

Readers with prior acquaintance with the science of behavior analysis may stumble about the absence of carrots and sticks, rewards, reinforcers, or punishers and discriminative stimuli thus far – and they have a point! Behavior analysis is a constantly developing discipline consisting of a number of schools with different conceptual and experimental positions. The most eminent behavior analytic school investigates behavior changes by identifying terms of what is often called a three-term contingency (see *e.g.* Skinner 1931, 1935, 1938, 1948, 1950, 1953a, 1953b, 1956; 1957 for more detail). The first term in that contingency is an antecedent event, also called discriminative stimulus. The second term is a response, and the third term is a consequence produced by the response. This last term is often called a "reinforcer" or a "punisher", depending on whether the consequence leads to an increase or decrease of the response. As illustrated in the title of Skinner's (1981) widely discussed paper *Selection by Consequences* (see *e.g.* the special issues discussing the paper in *Behavior and Brain Sciences*, 1984, and in *Norsk Atferdvitenskapelig Tidskrift*, 2016), the most eminent behavior analytic school tends to focus on the role of consequences in choice architecture. Nudging, however, focuses on the role of antecedents of behavior when analyzing choice architecture.

Changes in choice architecture referred to as nudging, do not program changes in consequences (reinforcers and punishers). This, of course, does not mean that no such changes in consequences occur. On the contrary, "naturally" occurring consequences, such as better health because of nudging food choices, are the desired long-term outcomes of nudging. Whether or not this outcome actually occurs is an experimental question, depending on the particular procedure and setting. Both nudging procedures and behavior analysis aim at answering such empirical questions. Behavior analytic findings propose that whereas the (long-term) positive outcome of nudging interventions fails to occur, designing a change of the contingency between choice and consequential events (reinforcers and punishers) might be worthwhile. Such an increased focus on consequences may be one of the benefits that nudging theory can gain from behavior analytic findings.

At the same time, there is abundant behavior analytic

evidence stating that the same important event can at times function both as an antecedent and as a consequence, or may simply coincide with the behavior in question (Baum, 2015, 2016; Baum and Davison, 2014; Davison and Baum, 2006; Rachlin, 1976; Shahan, 2010, 2017; Simon and Baum, 2017). Often these events enter into a feedback loop with behavior, as when a pigeon's finding food in a certain foraging patch leads to more search, and more search leads to finding more food, until the patch is depleted and, thus, the environment signals that it is time to choose another patch. These findings are hardly compatible with analyses in terms of three-term contingencies but they support the concept of important events serving as the signals for guiding behavior, as we presented above. This reconsideration of the role of antecedence shows how research in the nudging framework may contribute to refinement of behavior analytic theory and experimental practice.

Since both 100+ years of behavior analytic research (starting with Watson, 1913) and 10 years of explicit "nudging" (Thaler and Sunstein, 2008) shared the aim of mapping and channeling ubiquitous choice architecture, is it a sign of sloppiness that Thaler and Sunstein (2008) do not credit a single behavior analyst in their celebrated *Nudge: Improving decisions about health, wealth, and happiness?* Nudging and the broader findings from the field of behavioral economics appear to be widely acknowledged and endorsed[2]. Would the reception of nudging have been even better if it had been associated explicitly with a more than 100 years old discipline investigating the causes of human behavior?

Probably not. Likely, nudging would have been dismissed as behaviorism[3] –which, some are convinced of, is a bad thing (e.g. Tooby and Cosmides, 1992; Chomsky, 1957; Mahoney, 1989; Pinker, 1994, 2002; Schnaitter, 1999; Stillman, 1975). Behaviorists are frequently misconceived as advocates of what Sunstein (2014b) would call "hard" rather than "soft" behavior control[4]t and it is exactly the "soft" aspect of behavior control that makes nudging acceptable for many (Reisch and Sunstein, 2016; Sunstein, Reisch, and Rauber, 2017). However, as behavior analysts before us have pointed out:

> If a particular government-imposed contingency is soft rather than harsh, if it acts on means rather than ends, if all alternatives remain available, and if the person herself would ultimately have chosen the alternative now made less costly, more salient, or easier to obtain, then that governmental control is a nudge, and for Sunstein nudges are permissible. (Rachlin, 2015, p. 198)

Conclusions

Throughout this article, we call for an increased conceptual and empirical synergy between behavior analysis and nudge theory. We emphasize the functional manipulation of means, in order to reach "higher ends", well aware of the ethical considerations and implications that this statement contains.

The extended body of experimental behavior analytic literature may contribute towards shaping more effective and powerful nudges, which policymakers might be receptive to and put to the test with users. In this, and in many other cases, ethical debates concerning the legitimacy for behavior control naturally arises: Who controls the controllers? Humans and non-humans have been subject to behavior control long before behavior analysis and nudging made their appearances. Moreover, as Hansen (2015) has pointed out, we cannot neglect mentioning any policymakers' own blind-spot biases: failing to recognize one's biases is a bias in itself. Future research on the contact point of nudging and behavior analysis is needed to elaborate on these ethical considerations. After all, behavior control and paternalism represent two faces of the same coin; a coin playing a central role in both behavior analysis and nudging.

Another most distinguished asset and commonality between behavior analysis and nudging is their privileged focus on an empirical approach: experimenting on what works in both laboratory and natural settings. During the last century, behavior analysis has developed and refined effective methods for inducing behavior change in individuals. More recently, it has been suggested to scale these methods up to a societal level, the level at which nudging often is applied (see e.g. Biglan, 2017; Biglan, Ary, and Wagenaar, 2000, on upscaling multiple baseline designs).

In sum, nudging can profit from behavior analysis by getting a better understanding of the underlying mechanisms of behavior change, suggesting new hypotheses if previously used tools do not lead to the desired change, or if change is not sustained. For example, in order to enhance or sustain the effect of an intervention, one can focus on the consequences that a behavior has in a given choice architecture. A change of antecedents of behavior, as when changing defaults, is only one way to influence behavior. Nudging focuses primarily on this way. A change of consequences, that is, the effect of behavior on the environment, is another way to influence behavior. Behavior analysis focuses primarily on this way.

In our section *Behavior analysis in relation to nudging above*, we have put forward that certain changes in the environment, such as changes in social contact or in the access to resources, are *important events* in the sense that they have the power to influence behavior (see also Baum, 2012). Nudging has largely focused on those important events that precede behavior, whereas behavior analysis has largely focused on

[2] Richard Thaler is the sixth behavioral economist to receive the Nobel Memorial Prize in Economics, after Robert Fogel (1993), George Akerlof (2001), Daniel Kahneman (2002), Elinor Ostrom (2009), and Robert Shiller (2013). Source: theguardian.com/world/2017/oct/11/richard-thaler-nobel-prize-winner-behavioural-economics.

[3] In fact, *behaviorism* is the philosophy of science of behavior analysis, defining the foundations, methods, and implications of the science of behavior (Baum, 2017b; Moore, 1984, 1995, 1996). This means that it is a philosophical position on what qualifies as behavioral science, on the reliability of its theories, and on the ultimate purpose of the science of behavior analysis.

[4] Moreover, behaviorism is frequently misrepresented as a "blank slate" position arguing that our *entire* behavior originates in the environment we experience after birth.

important events that follow one occurrence of behavior and precede its future occurrences. Imagining a wild chicken searching for grains in a certain patch illustrates that many important events are simultaneously antecedents and consequences of activities. The event of finding grain leads to further searching, which leads to finding more grain.

The ambiguity of whether an event is an antecedent or a consequence, and the success of both behavior change by antecedents and behavior change by consequences, suggest a reinvestigation of whether it is pragmatically justifiable to attribute behavior change to either a change in antecedents or in consequences. These attributions are the pillars of nudging and behavior analytic arguments respectively. Possibly, behavior analytic theory can benefit from analyzing the covariance between behavior change and change in important events in the environment, independent of whether these events precede, concur with, or follow the behavior. In this way, results from nudging experiments support the refinement of behavior analytic thinking, for example by questioning the traditional primary focus on the third term, the consequence, in a contingency.

Finally, a tighter connection between behavior analysis and nudging benefits translational research from laboratory and field experiments to conceptual analysis. The mutual learning within fields concerned with behavior change is promising to become a sustainable practice. More and more policy makers will hopefully support this scientific approach, which has the power of nudging people's decisions, making them "light like a bird and not like a feather" (Paul Valéry, in Calvino, 1988, p.16; Rachlin, 2009, p. 129).

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