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Behavioral Policy and its Stakeholders

The value of contingencies and schedules of reinforcement: Fundamentals of behavior analysis contributing to the efficacy of behavioral business research

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Abstract
The effectiveness and sustainability of behavioral insights, which characterize contemporary evidence-based public policymaking and social regulations, are dependent on the establishment of a functional relationship between a desired behavior and its beneficial consequences. We address two fundamental concepts in the science of behavior analysis, namely contingencies of reinforcement and schedules of reinforcement, in order to contribute to the multidisciplinary discussion on tackling large-scale behavior change. As for many other disciplines, different conceptual frameworks may define the same phenomena. The behavioral perspective unites several disciplines.
The focus of the paper is to contribute to the growing field of behavioral solutions by focusing on the consequences of behavior. Behavioral economics has contributed largely by offering the design of choice architecture: deliberately manipulating the antecedents for appropriate behaviors. This is accomplished by changing the default solutions in forms, opting in, opting out of alternatives and so on, often described under the umbrella of nudging.
The contributions from our field of behavioral sciences is the selectionist perspective. This offers conceptual framework for the analysis of establishing, maintaining or changing behavior. The science of reinforcement and the effects of different schedules of reinforcement may contribute to the knowledge of why some behaviors are more easily established and are more resistant towards extinction than others, why they can be generalized over situations or how they can be influenced for lasting change.
Individual behavior must come into contact with contingencies sufficiently powerful to initiate behavior change; schedules are instrumental in maintaining the change. This comprises the ultimate challenge of policy makers, for the sake of their stakeholders.

Keywords
contingencies of reinforcement — schedules of reinforcement — behavioral business — behavioral economics — choice architecture

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Introduction

Decision makers are changing their approach to tackling contemporary social and organizational issues, and we may be witnessing what has been referred to as a "behavioral revolution" (Chen 2016, Sandaker 2016, Shefrin 2015). Traditionally, policy makers' attention has been directed towards understanding their stakeholders' minds and attitudes, as a preliminary step towards designing initiatives meant to overcome their shortcomings. However, policy makers have recently started to address the behavior of the citizens whom their policies are meant to serve: changing ongoing behavioral practices, establishing novel behavior, and maintaining behavioral patterns and modalities by designing sustaining environmental context.

The experimental framework resulting from this approach in policymaking is usually referred to as "What Works" (East 2016, Bloomberg Philantropies 2015); its empirical body of evidence is growing and spreading, with countries such as the United Kingdom, the USA and Australia leading the shift. A report issued in December 2015 by the Australian Public Service Commission concludes:

> "Influencing human behaviour is very complex and the effectiveness of traditional approaches may be limited without some additional tools and understanding of how to engage citizens in co-operative behavioural change. [...] In the areas of welfare, health, crime, employment, educa-

> tion and the environment, achieving significant progress requires changing behaviour". (Australian Public Service Commission 2015)

This turning historical phase requires a multidisciplinary systematization of research findings and experimental results. The main drivers of the shift in policymaking are the fields of behavioral economics, social and cognitive psychology, and law and political studies. Behavioral economics has explored, measured and mapped the gap between theoretically perfect economical behavior and actual human ingenuous choice. Social and cognitive psychology went a long way towards explaining this gap by discovering our limited computational capabilities and processing errors. Law and political science are concerned with the environmental design and ethical implications of the governmental "paternalism" in bridging this gap. The science of behavior analysis is rarely explicitly mentioned as a contributor to the shift we are observing; nevertheless, conceptual and empirical findings from behavior analysis are being endorsed and referenced across public policy studies and economics experiments.

It is our understanding that the conceptual underpinnings of maintaining desired change in behavior are not as frequently addressed as those relevant to initiating the behavioral change itself. For this reason, we mean to contribute to the evolving multidisciplinary field, by introducing the technical concept of reinforcement, which historically belongs to the domain of behavior analysis and denotes a rigorous and technical feedback process.

In this paper, we single out two well-researched concepts in the science of behavior analysis: contingencies of reinforcement and schedules of reinforcement. We need to understand these concepts in order to successfully influence human behavior. Contingencies and schedules of reinforcement are technical terms. Contingencies are the key to establishing new behaviors, and reinforcement schedules are vital for maintaining behavior over time.

Two lessons from behavioral economics

Bounded rationality

The concept of bounded rationality was introduced in 1955 by Nobel laureate Herbert Simon and has attracted the attention of both economists and psychologists. In 1972, Herbert Simon defined rationality as "A style of behavior that is appropriate to the achievement of given goals, within the limits imposed by given conditions and constraints" (Simon 1972, p. 161), including both individuals and organizations as the behaving agents. His stance represents a fundamental critique to the *homo economicus* model (Henrich, Boyd, Bowles, Camerer, Fehr, Gintis, and McElreath 2001) and rational choice theories (Rubinstein 1998), which predict constant optimization of choice in absolute terms, over its variable relative suitability. The concept of rationality is both descriptive and normative, saying something about our intention. It is difficult, however, to predict behavior based on intention. Thus, we need an empirically valid conceptual framework based on lawful relationships between behavior and environment. Predicting the outcome of choice behaviors may refer to this lawfulness, rather than the assumed intention of stable preferences over time.

However, empirical findings suggest limitations in our capacities in choice situations, resulting in relative choice optimization, or sub-optimization.

Instead of looking for limited rationality decision making in people's cognitive processes, we support the idea of "improving the environment rather than people's minds" (Gigerenzer and Engel 2006, p. 23). *Nudging* means modifying the environment in order to overcome the shortcomings of our bounded rationality, targeting for change the relevant behavior rather than optimizing mental processes or changing attitudes. A nudge "alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (Thaler and Sunstein 2008, p. 6).

Among the growing body of available nudging experiments[1], recent examples include reducing medical prescriptions dosage errors by simplifying the choice between microgram and milligram in a hospital in New Wales (Algate, Gallagher, Nguyen, Ruda, & Sanders (2015, p. 17), Halpern (2016, p.72)), and using goal-specific reminders to increase savings among the bank customers of three developing countries (Fiorillo, Potok, Wright, Peachey, and Davies 2014).

Heuristics

As pointed out by Gigerenzer and Engel (2006), heuristics should not be mistaken for biases: while they are frequently used interchangeably, a heuristic is a process, whereas a bias is an outcome of that process (Gigerenzer and Engel 2006).

According to Tversky and Kahneman (1974), heuristics come in three general clusters: *i*. representativeness, *ii*. availability, and *iii*. adjustment and anchoring. Heuristics come in a wide array of forms and modalities; within each cluster, they all share the feature of influencing our beliefs, *i.e.* "the attitude we have, roughly, whenever we take something to be the case or regard it as true" (Schwitzgebel 2015).

An individual may behave in a way that goes against what he believes to be right, good or smart. A heuristic can help reduce the cognitive dissonance originating from that gap between belief and action (Festinger 1957). Gigerenzer and Engel (2006) differentiate the functional properties of heuristics, which serve as the solution to a problem, from their ontological feature of representing the problem themselves, as second-best strategies (p.18): paraphrasing, we may argue whether heuristics are tentative and inaccurate solutions to a problem or the problem itself.

Either way, policy makers and researchers developed nudges to overcome these shortages, both in societal and organizational settings.

[1] A frequently updated list of interventions under the nudge umbrella can be found here: http://www.stir.ac.uk/media/schools/management/documents/economics/Nudge%20Database%201.2.pdf

To give just one example for each heuristics cluster, the fallacy of representativeness may be overcome by rearranging the referencing system concerning cars fuel efficiency information (Thaler and Sunstein 2009, p. 203). Furthermore, a widely replicated experimental procedure in a university cafeteria addressed the availability heuristic by making access to vegetables and fruit easier and increasing the cost effort for sweets and high-caloric snacks (Thaler and Sunstein 2008, p. 2).

As an example of adjustment and anchoring heuristics in action, one study investigated cause and effect relationships between self-reported happiness and dating frequency among students (Strack, Martin, and Schwarz 1988) (Thaler and Sunstein 2009, p. 26).

A psychological interpretation of choice

Bounded rationality and heuristics represent only two of the possible explanations to our minds fallacies. In Daniel Kahneman's "Thinking, Fast and Slow" (2011), which followed his Nobel Memorial Prize conferral in Economics in 2002, they are described as cognitive products and strategies enacted by a system 1: fast, unconscious, automatic, simple and error prone. On the other hand, our system 2 way of thinking is slow, conscious, effortful, complex and reliable (Kahneman 2011), and this famous conceptual differentiation represents the topic on which we wish to draw attention in this section. It needs be noted that Kahneman stressed that system 1 and 2 were "fictitious characters", and not physical entities (p. 29).

Procrastination, impulsivity and contingency - shaped behavior

Procrastination means putting off doing things that, for whatever reason, must or should be done. Sabini and Silver (1981) identify postponement and irrationality as the main elements of procrastination. Preferring more pleasurable activities and decisions over discounted longer term ones, and the subsequent inefficiency of outcomes when considering the actor's best interest, suggest that procrastination is a product of system 1. In Cass Sunstein's words, our behaviors leading to smaller short-term gains over larger long-term losses, feeds "a close connection between procrastination and myopia, understood as an excessive focus on the short term" (Sunstein 2014b, p. 36). It aligns closely to impulsivity, denoting a behavioral response lacking the analytical, forethought and mindful processing granted by the slower and more effortful system 2.

The behavioral alternative to the irrational system 1, or to procrastination as one of its possible byproducts, is a contingency-shaped behavior: the person learns from coming directly in contact with the consequences of that behavior (Daniels 2009).

Precommitment strategies and reminders (Sunstein 2014a) represent two nudges meant to prepare for the encounter between the behavior and the positive consequences that the behavior leads directly to. Some of the most recent nudging examples of contrasting procrastination and impulsivity by means of shaping the behavioral contingencies, include tackling smoking cessation (Sunstein 2015), boosting work productivity through web tools (Goldstein 2008), and replacing unhealthy eating behavior (Kroese, Marchiori, and de Ridder 2016).

The "Save More Tomorrow" employee saving plan exemplifies successfully the implementation of a nudge based on understanding these behavioral principles. Initiated in 1998 (Halpern 2012, Benartzi, Peleg, and Thaler 2007, Thaler and Benartzi 2004), the program counteracted procrastination, by making saving automatic and appealing, and impulsivity, by eliminating the loss aversion resulting from potential lower take-home and stressing the benefits of more comfortable retirement lives. The program default was that savings were increased proportionally, when wages were increased.

The positive impacts of the reward shifted from *contingent* (*i.e.* directly consequent) to delayed and rule-governed on the behavior of saving, which denotes its alternative modality of learning, described in the next section.

Obedience, compliance and rule-governed behavior

Contingency shaped behaviors may be associated with impulsivity and procrastination while rule-governed behavior might be associated with obedience and compliance, or just more rational behavior. Skinner points this out when he describe rule-governed behavior: "The behavior of a person who has calculated his chances, compared alternatives, or considered the consequences of a move is different from, and usually more effective than, the behavior of one who has merely been exposed to unanalyzed contingencies" (1969, p. 122).

Extending our analysis to the group level, we translate the social psychological constructs of obedience (doing as you are told to do) and compliance (doing as the others do) into behavioral terms as rule-governed behavior. In this social learning process, a learner does not have to be exposed to the consequences that the target behavior produces (Daniels 2009). Rule governed behavior may be conformed or compliant, but not necessarily. On the other hand, rule governed behavior may also lead to non-conformed behavior, since the person who calculates the alternatives and makes reflections on the benefits of more than one outcome, may end up not taking the easy (conformist) way out.

Rule governance represents the alternative in behavioral terms to the rationality of system 2. Compared to contingency-shaped behavior, it is more efficient: behavioral change is faster and it lasts longer (Hayes and Ju 1998). In fact, the role of the antecedents cuing reinforcers may result in boosting behavioral change, "when there is not enough time for people to have their behavior contingency-shaped" (Daniels 2014, p. 137).

An example of "being told what's best for us", instead of "figuring it out by ourselves", comes from a 2011 study by the Behavioral Insights Team, concerning tax compliance be-

havior (Behavioural Insights Team 2011). Truthful normative messages were added to the contents of the letter soliciting tax collection. The narrower the benchmarking group (from country to postcode area to town), the higher the collection rates. Sweeney and Phillips (2016) found comparable results when collecting parking ticket payments.

Another example derives from the utmost serious implications of compliance behavior in clinical environments and features a study meant to prime effective hand hygiene procedures in preventing hospital acquired infections (King, Vlaev, Everett-Thomas, Fitzpatrick, Darzi, and Birnbach 2016). In this case, too, the "prime", or the nudge, more generally, consists in establishing the learning contingencies of a rule governing present and future behavior.

The architecture of sensible choices

The preceding analysis links the psychological constructs of bounded rationality in decision-making choices to behavior analytic principles. Each choice behavior has antecedents and consequences, which, together with the behavior, constitute contingencies of reinforcement (Skinner 1969).

In the following section, we focus on this contingent relationship. Behavior is primarily a function of its consequences, but the choice architecture usually involves only the antecedents.

Moreover, when desired behavior change has been initiated, it needs to be maintained, and sometimes generalized over different situations. Even though the work-café may arrange contingencies to make healthier lunch choices easy, the behaviors should be generalized and maintained when making your dinner-choice in the grocery store on your way home from work.

Contingencies of reinforcement

Developing the classic three-term contingency originally conceptualized by Skinner (1938), we may speak of a contingency only when a functional relationship occurs between what precedes and what follows any behavior. It is usually referred to as the ABC model (Antecedent, Behavior, Consequences), in order to enhance its applications beyond the strictly behavior analytic community, which tends to describe it as a discriminative stimulus, preceding an operant behavior, that unlocks a reinforcer (or a punisher).

Contingencies of reinforcement, therefore, comprise the consequence(s) following a behavior that would not otherwise manifest themselves if the behavior were not produced. For example, in an industrial setting, a worker may receive a cash bonus contingent upon meeting the production plan target.

Reinforcing a behavior means increasing its frequency; that is, the likelihood that it will reoccur in similar circumstances in the future. In order to overcome the processing shortages that behavioral economics experiments have pinpointed, a deep understanding of contingencies is fundamental for modification of behavior through policy-making. Reinforcement must be available after the first occurrence of behavior, and it is essential that it is available to maintain desired behavior over time.

Let us illustrate our argument with the example of energy efficient (green) behaviors (Costa and Kahn 2013, Newell and Siikamäki 2014). Social messages and norms, availability of information of green print impact, and reminders of virtuous behavior are among the most widely implemented discriminative stimuli (antecedents) within the nudging "toolkit". The goal is replacing old energy-inefficient behaviors with new greener ones. Green behaviors generate the reinforcing consequences of social desirability: that is, resolution of internal dissonance between proscription and behavior, and agency towards environmental sustainability, respectively.

Beyond nudging techniques, a financial reinforcer may be made contingent on green behaviors. A cumulative economic incentive can be redeemed upon billable dues, or a discount on the unit price to customer can be in place. In the first case, the choice architect is positively reinforcing behavior, adding elements that increase the likelihood of its repetition; in the second example, the contingency of reinforcement is negatively fashioned, because energy efficient behaviors reduce expenses.

Understanding the contingent relationship between the behaviors policy-makers intend to change and their consequences is fundamental in order to drive and sustain behavior efficiently. This includes understanding that rewards and incentives indirectly linked to the behavior can establish counterproductive contingencies.

Whereas this section focused on initiating a contingent relationship of reinforcement, we next move to analyzing in which ways reinforcement may best be maintained.

Schedules of reinforcement

Once a reinforcer is presented contingent on the target behavior, decision makers must also secure the conditions for maintenance of desirable behavior change. Withdrawal of the contingency of reinforcement results in the extinction of the target behavior (Pierce and Cheney 2008). The effects of reinforcement are temporary and transient, but a lot depends on how reinforcers are scheduled, whether deliberately or by accident.

There is an extensive behavior analytic literature on this issue, from basic animal research (Ferster and Skinner 1957), to humans in individual settings (Pierce and Cheney 2008), and organizations (Daniels 2000, Daniels 2014, Daniels and Daniels 2004, Sims and Lorenzi 1992). The schedules represented in Table 1 are laboratory schedules used under controlled conditions. In real-life situations, the actual reinforcement schedules influencing individual behavior are more difficult to observe. Reinforcement may be long delayed or intermittent; different reinforcers may maintain the same behavior under different conditions; the same reinforcers may maintain different behavior under different conditions, and so on. This does not weaken our main point; it just serves to emphasize the laboriousness of getting a complete picture.

A schedule of reinforcement determines the frequency, magnitude and immediacy at which reinforcers are functionally related to a behavior. This, in turn, influences both the speed by which the behaviors are established and maintained, and the behaviors resistance towards extinction.

Reinforcement may be available continuously, *i.e.* each time the behavior occurs, or intermittently. In the latter case, reinforcement is contingent on the behavior only in some instances on an either fixed or variable schedule, based on time or ratio samples. Intermittent schedules can be time-based or frequency-based, which are also called interval and ratio schedules, respectively. The classification of different basic types of schedules is summarized in Table 1 and it is important to note that different schedules of reinforcement affect behavior initiation and maintenance in different ways (Sims and Lorenzi 1992). In addition, schedules may run concurrently or alternately and there may be more than one schedule in operation for a behavior.

Continuous reinforcement schedules are the fastest and most effective for establishing a new behavior; however, they are also the most demanding in terms of resources and their effects may endure for shorter intervals than those of intermittent reinforcement schedules (Pierce and Cheney 2008). Interval schedules are usually not as effective as ratio schedules, since they produce behavioral spurts directly preceding the temporal sample. Variable ratio schedules of reinforcement, despite the relative difficulty in initiating a behavior, are the most cost-effective and appropriate for maintaining the behavior they are designed to maintain (Sims and Lorenzi 1992).

Variable ratio (VR) schedules of reinforcement generate steady high rates of responding, as illustrated by slot machines and scratch lotteries. The efficacy of VR schedules has been demonstrated in businesses as well as in society. To illustrate our point, consider a fiscal initiative in China, which is being followed up by the authors of this paper through a forthcoming replication experiment in Europe.

Tax evasion often comprises a lack of paperwork, such as not issuing invoices. Instead of punishing and fining individuals and organizations for failing to record their orders of payment, the new *fapiao* (invoicing, in Chinese) program was based on positive reinforcement. The ordinary receipts printed on plain paper were replaced with scratch-and-win tickets, which entitled winners to cash prizes in a lottery, ranging from 5 to 50,000 Yuan (corresponding to approximately 0.75 to 7,500 US Dollars).

The initiative resulted in an increasing number of customers actively asking to be invoiced, in order to access the lottery, which paid out on a variable ratio schedule of reinforcement. Positive consequences on the governmental level included a boost in transaction declarations and subsequent taxable revenue increases (Wan 2014, p. 124). This fiscal initiative is sustainable not only because of the positive trend between incoming tax payments and cash outs due to the lottery system. The schedule of reinforcement effectively sustains long-lasting tax-compliant behavior among the participants of this experiment.

Conclusions

Behavioral economics, the cognitive constructs of bounded rationality and biases, and behavioral insights constitute important knowledge bases when promoting and sustaining large-scale behavior change.

The mastery of basic behavior analytical concepts, such as contingencies of reinforcement and schedules of reinforcement, may enhance our policy-makers' efforts towards shaping better organizations, and societies that are more efficient. Choice behavior is not free from biases, and this insight must guide our efforts. Supplementing descriptions and analyses from the other disciplines with the behavior analytic toolbox is a much-needed next step.

Drawing on Kahneman's earlier differentiation between system 1 and 2, and building upon different constructs of psychology of individual and collective choice, we propose additional valuable tools for empowering policy- and decision-makers.

The examples of nudges provided throughout this paper are cost-efficient and easily implementable tools to promote behavior change, for the better. However, as behavioral policy makers might well understand, once a desired behavior change is effected, the main challenge is to maintain, and possibly improve, the desirable behavior. Well-arranged choice architecture is important, and if the nudge works right, the individual is exposed to the contingencies of reinforcement that naturally support his behavior change.

Because of the novelty of this technology, and the lack of systematic and longitudinal replications, there is concern that the effect of nudges may not be sustained over time, when habituation occurs and the salience of the intervention starts fading.

Designing an environment that not only produces, but also maintains, the target behavior requires knowledge of reinforcement contingencies and schedules of reinforcement. The behavior analytic contributions towards studying their functions and structures should therefore be included in this new multidisciplinary research.

We emphasize the need for a systematic analysis of the contingencies of reinforcement, identifying drivers and outcomes of current and desired behaviors, at every stage of the policy proposal and intervention.

Finally, we endorse the need for choice architects to design schedules that move from continuous to intermittent, as the missing tile of fully efficient and sustainable choice behavior.

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Table 1. Classification of Reinforcement Schedules in the laboratory

ItemSchedules of Reinforcement	Continuous	Intermittent			
		Fixed	Variable		
		Interval	Ratio	Interval	Ratio
The reward (or punishment) is delivered:	Each time the behavior is recorded	On a regular time basis	On a regular frequency of behavior	On arbitrary intervals calculated from an average value	On arbitrary frequencies calculated from an average value
Example:	1:1 relation	Every 5mins; on a monthly basis	Upon presentation of 10 target behaviors	If the average is every 10 hours, rewards may be delivered at 8, 12, 10.5, 9, 9.5, 11 hours	If the average is every 10 responses, rewards may be delivered after 15, 5, 12, 14, 6, 8 responses

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