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Temporal Lagging and Under-Optimization in Resource Allocation

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Abstract
Through this research paper an attempt has been made to model the spending behavior of those people who make an excessive or sometimes intermittent expenditure on seemingly less relevant or irrelevant needs. It is assumed that one of their most important past needs has remained unfulfilled for a fairly long period of time for the want of resources. Under the influence of unresolved stress in his past due to resource deprivation the decision-maker is likely to display past-biased spending behavior in his present period when the resource becomes available. Spending persistently or lavishly on a past need while ignoring the importance of present needs acts as a defense mechanism not only to resolve the past stress but also to keep off the cognitive dissonance created by the divergence or the feeling of wrong decision making consequent upon the relative evaluation of present and past needs. We prefer to call this tendency of making time-consistent decisions as "temporal lagging" since the usual term "temporal discounting" represents present-biased time-inconsistent decision making behavior.

Keywords
Active Avoidance, Cognitive Dissonance, Cognitive Hysteresis, Hedonic Hysteresis, Temporal Discounting, Temporal Lagging;

I. Introduction
"The drawbacks of maximizing are so profound and the benefits so tenuous that we may ask why anyone would pursue such a strategy" (The Paradox of Choice, Barry Schwartz P. 94)
Temporal lagging is the tendency of a person to make an excessive or intermittent expenditure on a specific past unfulfilled need irrespective of its present relative importance in the overall need-set, thus resulting into a net economic loss or dissonance. In other words, it is the condition in which a person's realized satisfaction from an expenditure on a past unfulfilled need falls short of the utility of money forgone because of higher opportunity cost i.e., when both present and past needs are considered simultaneously. Thus, expenditure is excessive in terms of opportunity cost and the dissonance is the negative emotional feeling of this divergence by the decision-maker himself. Unlike in temporal discounting where an individual is present-biased, in temporal lagging he is past-biased or time-consistent, at least, with respect to this unfulfilled need. However, it is important to mention that temporal lagging itself is a special case of temporal discounting where reference-point of the decision-maker does not shift because of non-availability of resource at the time when need arises and intensifies.
Buying a big house by one who suffered a lot in his society for not having a good house in his past; spending heavily on a child to make him doctor because the parent himself/herself missed the chance to fulfill this need; buying a number of cars by a person who had none a few years back; and spending heavily on marriages and parties are often temporally lagged preferences. Such preferences are likely to be made largely by the people in the societies which have recently made some strides of development and have observed a substantial rise in purchasing power or those people who have somehow suffered in their past for the deprivation of adequate resources when compared to their immediate counterparts.

II. Review of Literature
Since the topic is of inter-disciplinary nature, a vast and voluminous literature comprising of research works from diverse fields is available. It is, therefore, practically impossible to extract from it a condensed account without missing, at least, some important ones. We attempt to evaluate only the most important works from economics, psychology, sociology and neurobiology and integrate the important results to arrive at the conclusion.
The concept of inter temporal choice in economics is as old as the discipline itself. Not long after Adam Smith called attention to the importance of inter temporal choice for the wealth of nations, when the Scottish economist, John Rae was examining the sociological and psychological determinants of these choices (Frederick et al., 2002). For nearly eighty years economists have analyzed inter temporal decisions using the Paul Samuelson's Discounted Utility (1937) model which assumes that people evaluate the pleasures and pains resulting from a decision in much the same way that financial markets evaluate losses and gains, exponentially discounting the value of the outcomes according to how delayed they are in time (Berns et al., 2007). Inter-temporal choice became firmly established as a distinct topic in 1834, with John Rae's publication of "The Sociological Theory of Capital". Along with inventing the topic, Rae also produced the first in-depth discussion of the psychological motives underlying inter temporal choice. Bowm-Bawerk added a new motive to the list proposed by Rae, Jevons and Senior, arguing that humans suffer from a systematic tendency to underestimate future wants. In "The Theory of Interest" (1930) Fisher developed what is still thought of the modern theory of intertemporal choice (Thaler, 1997).Seminal papers by Allais (1953), Ellsberg (1961), and Markowitz (1952) pointed out anomalous implications of expected and subjective expected utility. Strotz (1955) questioned exponential discounting. Later scientists demonstrated similar anomalies using compelling experiments that were easy to replicate (Kahneman and Tversky 1979 on expected utility; Thaler 1981, and Loewenstein and Prelec 1992, on discounted utility) (Camerer et al., 2004).
The concept of temporal discounting is most important from the viewpoint of our topic because it is based on the concept of time-inconsistency (i.e., on the assumption that decision-maker's preferences change over time) whereas our proposed model is based on time-consistency. Temporal discounting refers to the tendency of people to discount rewards as they approach to temporal horizon in the future or the past (Bickel et al., 1999). Traditional models of economics assumed that the discounting

function is exponential in time leading to monotonic decrease in preferences with increased time delay; however, more recent neuroeconomic models suggest a hyperbolic discount function which addresses the phenomenon of preference reversal. Prof Laibson in 1997 proposed a "quasi-hyperbolic" discount function which approximates hyperbolic discount function in discrete time (Green and Myerson, 2004).

Neurobiological and neurocognitive research findings seem to reveal that there are multiple brain areas involved in dealing with situations of risk, uncertainty and inter temporal decision making. In tasks requiring individuals to make predictions when there is some degree of uncertainty about the outcome, there is an increase in activity in area BA8 of the frontomedian cortex (Volz et al., 2003) as well as more generalized increase in activity of the mesial prefrontal cortex (Knutson et al., 2005) and frontoparietal cortex (Paulus et al., 2001).

The prefrontal cortex is generally involved in all reasoning and understanding, so these particular areas may be specifically involved in determining the best course of action when not all relevant information is available. In situations that involve known risk rather than uncertainty, the insular cortex seems to be highly active (Paulus et al., 2003).

In addition to the importance of specific brain areas, there is evidence that the neurotransmitter 'dopamine' may transmit information about uncertainty throughout the cortex. Dopaminergic neurons are strongly involved in the reward process and become highly active after an unexpected reward occurs (Fiorillo et al., 2003).

In addition to neurotransmitters, inter-temporal choice is also modulated by hormones in the brain. In humans, a reduction in cortisol, released by hypothalamus in response to stress is correlated with high degree of impulsivity in inter-temporal choice tasks (Takahashi, 2004). Interestingly, drug addicts tend to have lower levels of cortisol than general population, which may explain why they seem to discount the future negative effects of taking drugs and opt for the immediate positive reward (Plihal et al., 1996).

The general view is that stress or stress hormone levels induce inverted U-Shape dose effects in learning, memory, and plasticity (Baldi and Bucherelli, 2005).

The response to stress, irrespective of the stress producing agent has been called as the "general adaptation syndrome" and its derailments the diseases of adaptation. Anything that causes stress endangers life, unless it is not met by adequate adaptive responses: conversely, anything that changes life causes stress and adaptive responses (Selye, 1950). A prolonged effort to adapt to the stress response leads to allostatic load or exhaustive wear and tear on the body (McEwen, 2003).

Decades of study have differentiated three systems responsible for monitoring and responding to the environment around us and for our mental processing on incoming stimuli: alerting, orienting and executive control (Corbetta and Shulman, 2002).

Newly emerging theories describe that the three attention networks mentioned above are actually part of broader complement of brain networks. One of these networks is "task positive"; its recruitment is associated with active engagement in goal directed tasks involving attention to the world and evaluating the salience of external stimuli (Seeley et al., 2007). It can be called as "looking-out" system. The task-positive network (TPN) is a network of areas in the human brain that typically responds with activation increases to attention-demanding tasks in functional imaging studies (Fox et al., 2005). Another network called Task-Negative network or default mode network acts as a "looking out" system. It is considered to be involved mostly, if not entirely, in involuntary actions (Fox et al., 2006). Far from being passive however, default activity during fixation is hypothesized to reflect unconstrained and internally focused cognitive processes (Buckner et al., 2008). Past decade of neuroscience research has revealed that as one network is increasingly engaged, the other is decreasingly engaged (Spreng, 2012).

Psychologists have studied goal-seeking behavior using different models and approaches. The movement toward a goal is generally meant to reflect the functioning of a negative, or discrepancy reducing, feedback loop (MacKay, 1966; Miller, Galanter, & Pribram, 1960; Powers, 1973) and the existence of discrepancy enlarging loops is also recognized in which deviations from the comparison point are increased rather than decreased (Vohs and Baumeister, 2011). Festinger's notion of cognitive consistency (Festinger, 1957) can be helpful for the theoretical explanation of goal-seeking behavior.

III. Research Methods and Materials

This research work is a meta-analysis and is exclusively based on secondary data. An attempt has been made to establish every argument on the basis of already established results and/or the deductions derived from them.

A. Results and Discussion

We propose the following model to analyze the influence of past ends on current spending behavior and its consequences:

Explanation of the Model

If a certain need (which is vital for an individual) remains unsatisfied for a quite long period of time for the want of resources, it leads to distress which in turn causes some significant social, cognitive and neurobiological changes giving rise to a specific behavior and when resources are availed and spent on this need. As the model seeks to explain the spending behavior of those people who experience resource deprivation in their past, therefore, we prefer to incorporate the notion of goal-seeking behavior and assume cognitive consistency as the only goal of decision maker's actions. For the proposed explanation we depend on the concept of feedback control because it applies readily to moving targets (Beer, 1995) and is better suited to the process of self-regulation, homeostasis and internal consistency. Thus, any movement of the decision maker towards a goal (i.e., the comparison point) reflects the functioning of a discrepancy reducing feedback loop and any movement away from the goal leads to enlarging of discrepancy loop. In the latter case, the discrepancy is enlarged with respect to one goal and reduced with respect to another. Such dual influence is said to occur in instances of what is called active avoidance (Vohs et.al., 2011).

For simplicity and objectivity, we classify needs into two groups-vital needs and auxiliary needs. A vital need is one which if not satisfied causes an unresolved stress to an individual and an auxiliary need is one which if not satisfied can be sidelined or done away with.

1. Assumptions

1. The need under consideration is vital need.
2. All the wants are transitive i.e., the course of behavior is regulated or motivated by a tightly organized hierarchy of goals.
3. The ultimate goal of need fulfillment is cognitive

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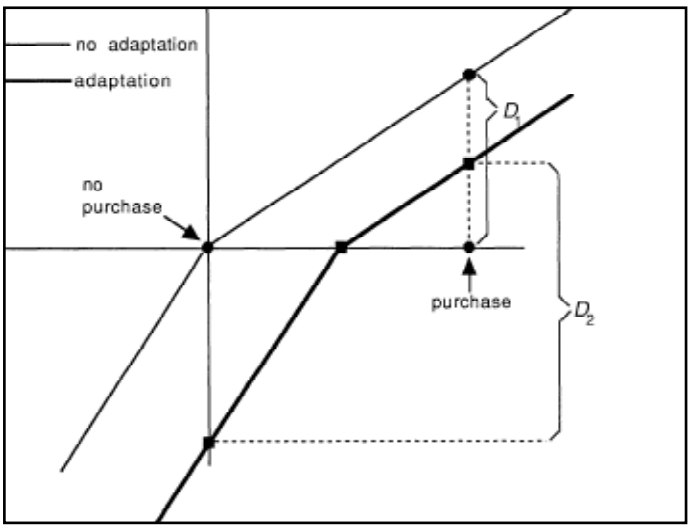
consistency.

4. The goal completion can take place through aspiration achievement (optimization) or satisficing (under-optimization) only.
5. The individual is deprived of the resource for a fairly long period of time.
6. He has neither resource for the direct satisfaction of the need nor is any alternative way available to him to reduce or mitigate the stress (e.g., no credit facility; no free substitutes).

Resource is spent on the need as soon as it becomes available.

Given the above assumptions, the decision-maker passes into two crucial stages:

Ante-Consumption Stage: Owing to resource deprivation for a considerably long period of time the decision-maker is under a persistent stress. His brain's default mode of operation (or task-negative network) remains largely underutilized as the decision maker's focus during most of his wakeful rest period is on the past unfulfilled need and its "task-positive network" remains engaged most of the time since if one is increasingly engaged, the other is decreasingly engaged (Spreng, 2012). The persistent focus on the unfulfilled want also leads to a decrease in decision-maker's emotional involvement in social contacts and physical proximity to goods and services (the temporal proximity being already diminished by the non-availability of purchasing power). As they are the main factors causing reference-point shifts (Hosch et al., 1991) so he stays in his past both socially and psychologically, at least, with respect to this need. Because of non-availability of resource the decision maker is forced to select a less preferable social environment. For selecting a relatively inferior social status the decision maker not only lags behind his previous immediate counterparts both socially and psychologically but also considerably overestimates the importance of the need. The decision-makers' efforts are persistently directed towards the goal which seeks to reduce (or at least not increase) the deviation of the decision-maker from the goal. Thus, a peculiar goal-directed and somewhat non-volatile loop which we call as cognitive hysteresis is created in which a decision-maker who is deprived of the resource for a considerably long period of time abates certain social contacts and largely avoids looking at new ends. Therefore, his desire to satisfy the need is further intensified. The phenomenon of desire getting intensified in deprivation is due to loss aversion, i.e., the pleasure of possessing an object is less than the pain of not possessing it.



The cognitive hysteresis helps the decision maker to move towards or at least not move away from the incentive (i.e., cognitive consonance). But as long as the decision maker is deprived of the resource, his position remains stationary in the hierarchy of goals and there is no question of temporal discounting.

The two important deductions can be made with regard to decision maker's behavior in his ante-consumption stage:

I. The tendency of giving importance to the same previous goal rises or (or at least does not diminish) because the expected consonance associated with the need fulfillment is relatively more than expected dissonance associated with the sacrifice of resource (ante-consumption static comparison).
II. The tendency of giving importance to the same previous goal does not diminish because there are no other ends more important than the given end (ante-consumption adaptive comparison).

Since both the tendencies of the decision maker are directed to meet the same goal, on both static and adaptive scale the decision maker's tendency is towards optimization of resources.

Post-Consumption Stage: Once the decision-maker avails the resource he most preferably uses this resource to satisfy the want under consideration to relieve him from the long-felt cognitive burden. Thus the cognitive hysteresis loop is broken and the decision maker begins to evaluate his spending decisions on the basis of temporal discounting which is the tendency of people to discount rewards as they approach a temporal horizon in the future or the past (Doyle, 2013). He is, therefore, likely to make more than optimum expenditure. Longer the period of deprivation, more he needs resources to mitigate the cognitive burden. More he spends the resources on that past need more he avoids looking at new ends because more dissonance is associated with under-optimized decisions in post-consumption adaptive comparison. Thus, we propose that in case of an unfulfilled goal, a person is usually forced to ignore new ends at least temporarily because of being deprived of the resource. Since under the static comparison the relative importance of the given want increases or at least does not diminish over time and also there is a net cognitive dissonance associated with adaptive comparison, the decision maker is likely to prefer the strategy of active avoidance. Thus the decision-maker deliberately makes static comparison to avoid cognitive dissonance and ensure consonance. We prefer to call this post-consumption loop as "hedonic hysteresis". Given the purchasing power, the importance attached by a decision maker to a goal is determined by the net force of the following two feelings of opposite effect associated with every act of expenditure:

I. After making expenditure the decision maker's tendency of giving importance to the same previous goal diminishes because the satisfaction realized from need fulfillment is more than the dissonance associated with the sacrifice of resource (post-consumption static comparison).
II. The decision maker's tendency of giving importance to the previous goal strengthens because of continuously increasing opportunity cost of previous ends (Post-consumption adaptive comparison).

If the latter exceeds the former, the decision maker is likely to avoid the post-consumption adaptive comparison and prefer the previous goal. This results in the tendency of temporal lagging. Since, the efforts are directed to avoid the pain of dissonance and to maintain the status quo, the decision maker's behavior is under-optimizing under adaptive scale.

As the amount of expenditure to be made on the past unfulfilled want depends on the resource available at that point of time and the relative intensity of the want prior to the expenditure, therefore, the urge to spend on it cannot always be exterminated in one go or single dose of expenditure. Also, since the relative intensity of the want itself is increased (or at least not allowed to diminish) by cognitive hysteresis effect and given the resource constraint, in certain cases a particular want cannot get completely satisfied even throughout the life. This is the reason why certain normal people spend seemingly lavishly and intermittently on a specific past unfulfilled need.

Sometimes, increasing social contacts may strengthen the decision-maker's tendency of temporal lagging if most of his immediate peers too are in the same loop. It may rather give rise to a spending-competition in respect of the common lagged preference. For example, a huge unnecessary expenditure will be made on the construction of houses by the people in general in an area where in recent past they used to live in poor housing conditions. It will lead to wastage of resources on mass scale in terms of underutilized space, extra maintenance cost and huge opportunity cost.

The hedonic hysteresis, though seemingly myopic act as an important coping strategy or defense mechanism. It is, in fact, the best of the worst strategies available to the decision maker.

The Conditions for Optimization

The necessary and sufficient conditions for optimization are given below:

Condition I:

$^{U}A \geq {}^{U}M$ (Necessary Condition)

Condition II

There exists no unfulfilled want 'B' in the overall need-set, such that;

$^{U}B > {}^{U}A$ (Sufficient Condition)

Where; ^{U}A is utility of want 'A';
^{U}M is utility of money spent on it;
^{U}B is the utility of want 'B';

However, in case of time-consistent decision-makers:

$$^{U}A \geq {}^{U}M$$

But there exists at least one want B in present period, such that;

$$^{U}B > {}^{U}A$$

The time-consistent decision-makers fulfill only necessary condition but not sufficient condition because in the overall need-set there exists at least one need belonging to his present set of needs which is having more utility than the need satisfied (as felt by the decision-maker himself, that is why he rejects the adaptive comparison).

Now, let the decision-maker's total utility functions of need A and need B be described as $^{U}A = f(x)$ and $^{U}B = g(x)$ respectively and their corresponding marginal utility functions be described as $^{MU}A = f'(x)$ and $^{MU}B = g'(x)$, then the magnitude of under-optimization can be worked out as under:

$$\int g(x)dx - \int f(x)dx = w$$

Where, $w > 0$ and denotes the magnitude of under-optimization.

IV. Discussion

In order to get maximum consonance from satisfying the need and to get rid of the additional stress caused by the feeling of loss, time-consistent decision-makers often prefer to be in hedonic hysteresis making static comparisons. It is only a less than optimum level of equilibrium. This serves them two purposes (i) the need gets satisfied, and (ii) it acts as a hedge against future risk to prevent probable health damage which could otherwise occur due to unresolved stress. It is because of this reason that some people seem to spend not only lavishly on a given need but lavishly on the same need again and again.

Is it anyway justified to say that temporally lagged preferences are less efficient than time-inconsistent preferences? If they get the satisfaction at least worth the loss they incur, how can we say that there is any under-optimization of resources? And, is it justified for a person whose reference point has already shifted forward to compare others' time-consistent preferences to his own reference point?

Temporally lagged preferences are relatively less efficient at least in terms of additional cost involved by the decision-maker (when compared to time-inconsistent decision-makers) and economic and non-economic consequences borne by him due to non-availability of resource at the proper time. They are at a loss when adaptive comparisons are made while time-inconsistent decision-makers get consonance when viewed from any of the comparison. It is for this reason that time-consistent decision makers are reluctant to evaluate their position on the adaptive scale but the time-inconsistent decision-makers, who give grater importance to present ends, observe the feeling of consonance or at least, no feeling of dissonance while comparing their present position to any of the present or past reference point.

V. Conclusion

The time-consistent decision-makers bear additional cost both in terms of better opportunities forgone and direct and indirect consequences of stress borne by them. They themselves realize this feeling that is why they avoid adaptive comparisons. They are under-optimizing economically as well as psychologically. Therefore, temporal lagging leads to under-optimization of resources.

From time-consistent decision-makers' viewpoint and in the circumstances of non-availability of resources, temporal lagging is the best of the worst strategies available to the decision-maker and is only a satisficing not maximizing strategy and from macro-angle, temporal lagging which is caused by non-availability of resources at the right time is rather a more serious problem. It is a forced condition and in fact a grave concern to the policy-makers. Millions of people all over the world living in deprived conditions are at the helm of unconscious psychological defense mechanisms. The opportunity cost of living for them is quite high in terms of both material pursuits of life and health effects that they forego.

Policy-makers must think and rethink on the issues of equity in the distribution of income and wealth, provision of education and health services and framing inclusive growth and development strategies. These issues need to be considered more seriously in countries like India where the new economic policy of liberalization and privatization has become inevitable and still a huge chunk of population lives below poverty line. In the absence of sincere and serious policy measures, the additional burden will largely fall on deprived sections of the society by way of consequences

of both rising income disparity and changing social and political structure of the country.

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