Procrastination and Commitment

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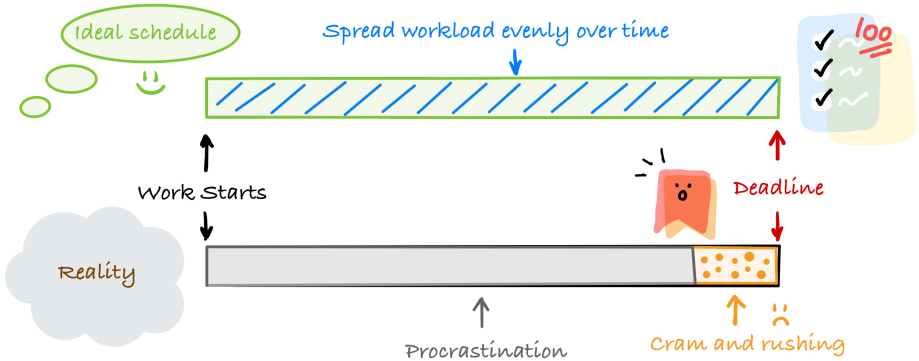
האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

Motivation

People procrastinate, e.g., students finish assignments near due date



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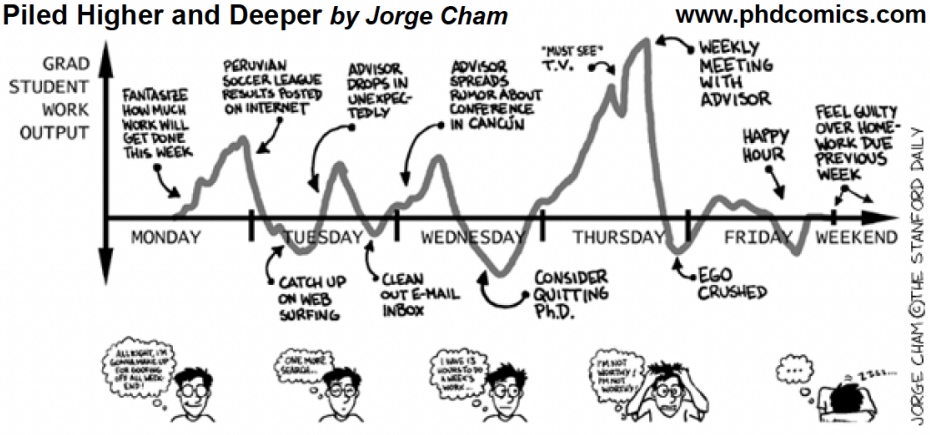

title: "Graph - Work output" - originally published 5/3/1999

Motivation

A present-biased agent commits to completing a long-term task before deadline

Two types of contributing factors to procrastination:

1. personal factors/behavioral frictions: present bias, naivete
2. environmental factors/task features: workload, deadline

Questions

- *How do behavioral frictions and task features interact in shaping procrastination?*
- *Can intermediate short-term goals benefit a present-biased agent?*

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  - agent with higher behavioral frictions is more sensitive to changes in task features
- *Can intermediate short-term goals benefit a present-biased agent?*
  - **agent can partially commit to procrastinating less but cannot benefit from it**

Contribution to Literature: Unintented Side-Effect of Commitment

Theory: commitment devices can counter time inconsistency & improve welfare

- e.g., Strotz (1956) Laibson (1997) Gul & Pesendorfer (2001) Fudenberg & Levine (2006)

Experimental and field evidence: insufficient demand for commitment devices

- e.g., Ashraf & Karlan & Yin (2006)

Three existing approaches to explain the gap between theory and reality

1. Naivete: people underestimate their future present bias
   - e.g., O'Donoghue & Rabin (2001)
2. Preference for flexibility: payoff-relevant information may arrive later
   - e.g., Amador & Werning & Angeletos (2006)
3. Direct cost: price of device exceeds its benefit
   - e.g., Laibson (2015)

Model

Single-agent dynamic decision-making

Task: complete total workload $w > 0$ within the deadline $T > 0$

Effort

- Effort (or work intensity) at time $t \in [0, T]$: $y_t \geq 0$
- Workload finished by time $t \in [0, T]$: $x_t \equiv \int_0^t y_\tau d\tau$
- Flow cost of effort: $c(y) = \gamma y^\alpha$ where $\gamma > 0, \alpha > 1$

Model: Time Preference

Discounting Function: how to evaluate future utility flows at present

Sophistication: how to anticipate future choices

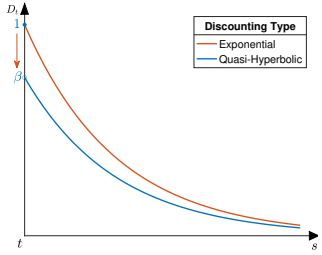
Discounting Function

Continuous-time quasi-hyperbolic discounting (*Harris & Laibson, 2013*)

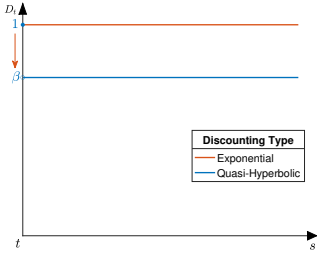
- The discount factor evaluated at time t for utility at time $s \geq t$ as

$$D_t(s;\beta,\delta) = \begin{cases} 1 & \text{for } s = t, \\ \beta e^{-\delta(s-t)} & \text{for } s > t, \end{cases}$$

where $\beta \in (0,1]$ denotes present bias, $\delta \geq 0$ denotes the exponential discount rate



(a) $\beta \in (0,1)$, $\delta > 0$



(b) $\beta \in (0,1)$, $\delta = 0$

Sophistication

Allow for mistakes in self-perception

- Perceived present bias $\hat{\beta} \in [\beta, 1]$: sophisticated ($\hat{\beta} = \beta$); naive ($\hat{\beta} > \beta$)

Model: Dynamic Optimization

Agent exerts effort over time to minimize overall effort cost for task completion

Intrapersonal game btw current self and future selves: Markov-Perfect Equilibrium

- directly payoff-relevant info: remaining work and remaining time
- at any time $t \in [0, T)$, given her perception about future selves' choices, the current self chooses the optimal effort input under the **actual** present bias β
- perceived future selves' choices are consistent with the **perceived** present bias $\hat{\beta}$

Characterize Work Schedule and Individual Welfare

Proposition (Work Schedule and Effort Costs for a Long-Term Task)

Let $B = (\beta/\hat{\beta})^{\frac{1}{\alpha-1}}(\alpha-1)/(\alpha-\hat{\beta})$. The agent's work schedule is: $\forall t \in [0, T)$,

$$x_t(\mathcal{T}, \mathcal{B}) = w\left[1 - \left(1 - \frac{t}{T}\right)^B\right],$$

$$y_t(\mathcal{T}, \mathcal{B}) = \frac{wB}{T}(1 - \frac{t}{T})^{B-1}.$$

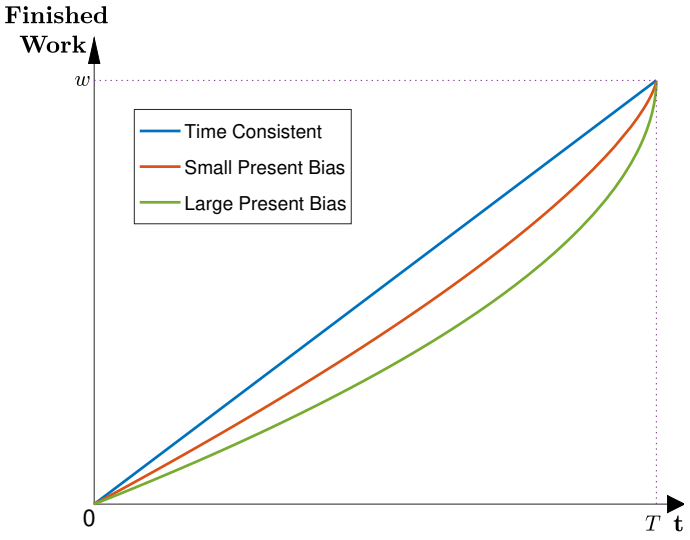
The cost function (or the ex-ante perceived cost) is

$$C(\mathcal{T}, \mathcal{B}) = \frac{\gamma B^{\alpha-1} w^\alpha}{T^{\alpha-1}}.$$

The long-run cost associated with the work schedule is

$$LC(\mathcal{T}, \mathcal{B}) = \frac{\gamma B^\alpha w^\alpha}{[1-\alpha(1-B)]\,T^{\alpha-1}}.$$

Committing to One Final Deadline



Committing to Intermediate Deadlines

- A natural class of commitment devices to regulate a long-term task: committed to a successive series of short-term goals
  - e.g., milestones for graduate studies, weekly report on work progress

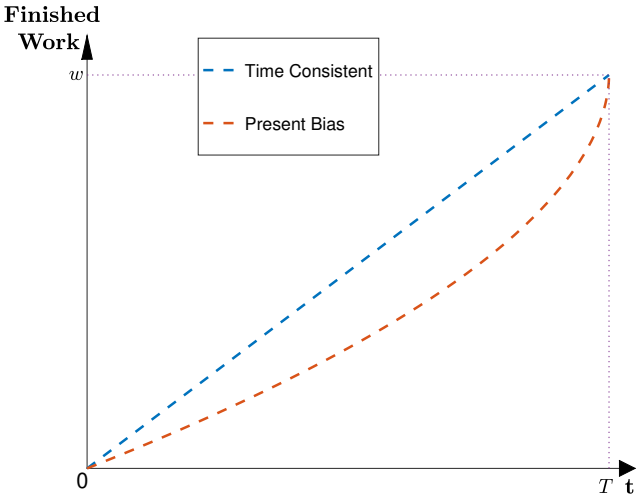
- Suppose the agent can commit to some intermediate goals:

$$G^k = \{(w_1, \tau_1), (w_2, \tau_2), \cdots, (w_k, \tau_k)\}$$

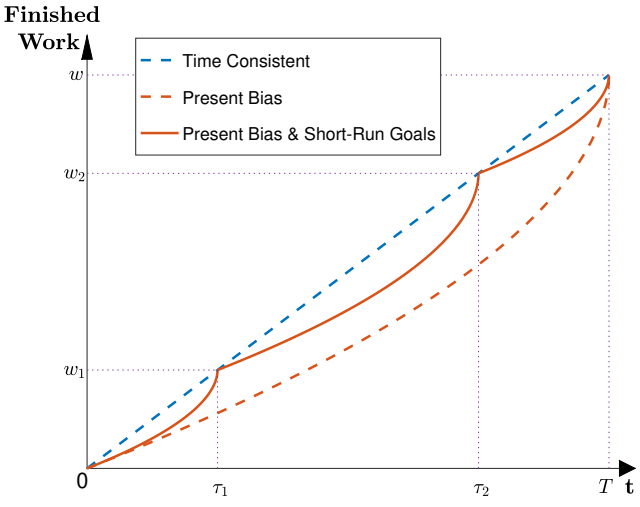
  with $(w_k, \tau_k) = (w, T)$

- Lesson from time inconsistency literature
  - Commitment devices can strictly enhance long-run welfare for a present-biased agent

Work Schedule under One Final Deadline



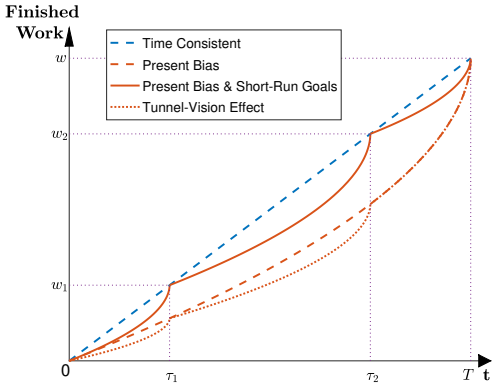
Work Schedule under Optimal Short-Term Goals



The Value of Commitment Device

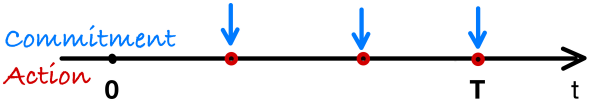
- Compare overall effort cost for task completion with and without short-term goals
  - The ex-ante perceived cost: $\hat{C}(G^k) \geq C(w, T, \beta, \hat{\beta})$
  - The long-run cost: $\hat{LC}(G^k) \geq LC(w, T, \beta, \hat{\beta})$
- No intermediate goals decrease the overall effort cost for any agent

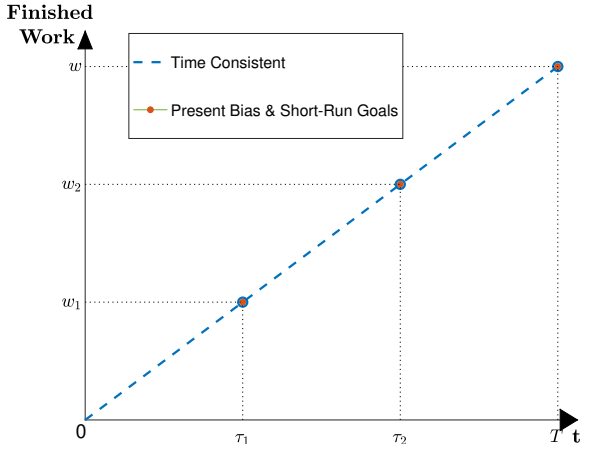
Two Forces at Play



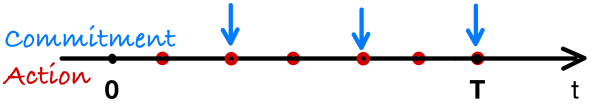
1. *Keeping on Track* $(+)$: induce early work so less work left near the final deadline
2. *Tunnel Vision* $(-)$: focus on and rush for the urgent short-term goal at each phase

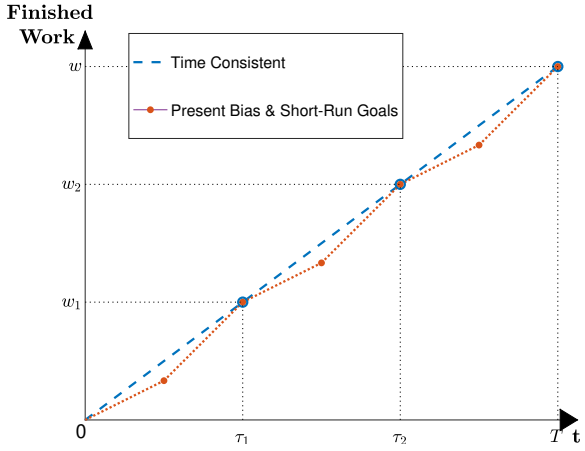
Full Commitment



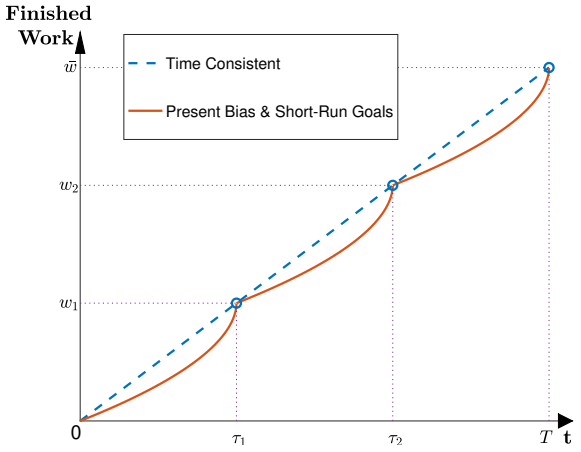


Partial Commitment

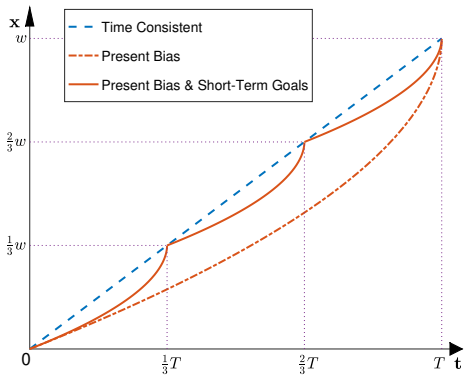




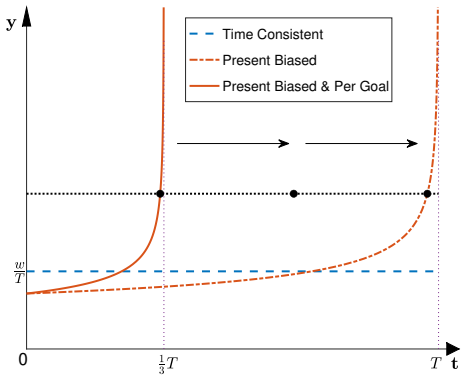
Relative Frequency of Actions and Commitments Matters



Constant Overall Effort Cost to Task Scale



(a) Level Comparison



(b) Slope Aggregation

Conclusion

- I develop a model in which a present-biased agent chooses how to distribute workload over time by a deadline
- I provide closed-form solutions for individual work schedule and welfare
  - behavioral frictions of present bias and naivete add curvature to the work trajectory
  - behavioral and environmental frictions reinforce each other in undermining welfare
- Partial Commitment can make people procrastinate less; but in terms of individual welfare, it is at best of no value, if not harmful.
  - A negative effect arises under present bias and limited commitment
  - It grows as the frequency of actions relative to the frequency of short-term goals increases, and it can be significant enough to completely neutralize and even strictly dominate the positive disciplining effect of commitment

Bibliography

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