Vision and Flexibility in a Model of Cognitive Dissonance

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March, 2010
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Motivation

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- What are the fundamental forces behind these anomalies?
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The first question: Why the conformity bias? Why is it so difficult to exhibit a vision?
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The second question: Why the anchoring effect and the confirmatory bias? Why is it so difficult to be flexible?
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- Vision and flexibility are clearly indispensable for effective decision making.
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- Why are they so rare to be found?
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Why are they so rare to be found?

We attempt to answer this question by building on the theory of cognitive dissonance.
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Example 1: Sour Grapes

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- The fox manipulates its belief system, to preserve internal consistency.
Example 2: A worker in a hazardous job

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- The student has some self-esteem concerns and would like to think that he is more capable than others.
- The belief that he is capable and the fact that he failed the test are contradictory.
- The student may conclude that there was a flaw in the text and hence it was meaningless, to preserve his self-esteem concerns.
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- The last premise is particularly important, as it links distorted beliefs with distorted actions.
- People can believe what they want to believe, to some extent, but that is not costless.
Main results

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- The model yields three types of behavioral bias.
  - Consistent information is exaggerated (obsessive).
  - Inconsistent information is discounted (stubborn).
  - Early information is discounted (indecisive).
- The first two results are related to the lack of flexibility while the last is to the lack of vision.
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In each period, DM observes a signal, evaluates it, and takes an action $a_t \in [0, 1]$ based on the evaluation of the observed signal.
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- In each period, DM observes a signal, evaluates it, and takes an action \( a_t \in [0, 1] \) based on the evaluation of the observed signal.
- DM differs in innate ability \( \eta \in [0, 1] \).
- For the subjective self, its distribution is \( F \), with mean \( \mu := \int \eta dF \) and variance \( \sigma^2 := \int \eta^2 dF - \mu^2 \).
The action

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The first-order condition implies that the optimal action is $a = \rho$. 

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- The signal is either informative or noisy, and the (objective) probability that it is informative is $\tilde{\gamma}$.
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We refer to this probability as the informativeness of the signal.
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Signals

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In period 2, things unfold themselves and
\[ \text{prob}\{s_2 = \theta \mid \text{the signal is informative}\} = 1. \]
The intrapersonal conflict

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The intrapersonal conflict

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- The subjective informativeness is chosen as a consequence of the intrapersonal conflict between the objective self and the subjective self.
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- There is no way to distinguish whether a given signal is informative or not, beyond its objective probability $\gamma$.
- However, DM has the ability to manipulate and deceive herself by assigning the subjective informativeness $\gamma_t$ to each observed signal.
- The subjective informativeness is chosen as a consequence of the intrapersonal conflict between the objective self and the subjective self.
  - The objective self represents a rational side of DM who is far-sighted and objectively updates the belief.
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The subjective informativeness is chosen as a consequence of the intrapersonal conflict between the objective self and the subjective self.

- The objective self represents a rational side of DM who is far-sighted and objectively updates the belief.
- The subjective self represents a primitive and instinctive side who is myopic and cares about her self-images (ego preferences).
The beliefs

Let $g_t$ denote the perceived informativeness of the signal in period $t$, where $g_t = \tilde{\gamma}$ for the objective self and $g_t = \gamma_t$ for the subjective self.
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- The belief about the current state is defined as

$$
\rho_1(s_1; g_1) := \text{prob}\{\theta = 1 \mid s_1, g_1\},
\rho_2(s_1, s_2; g_1, g_2) := \text{prob}\{\theta = 1 \mid s_1, s_2, g_1, g_2\}.
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The belief about her own ability type is defined as:

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\mu_1(s_1; g_1) := E[\eta \mid s_1, g_1],
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The range of the belief about the current state

\[ 0.5 \quad \frac{1+\tilde{\gamma}\mu}{2} \quad \frac{1+\mu}{2} \]

**Figure 1: The manipulable range of the belief when** \( s_1 = 1 \)

\( (\mu = 0.5, \tilde{\gamma} = 0.5) \).
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**Figure 1:** The manipulable range of the belief when \( s_1 = 1 \) 
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\[ s_2 = 0 \quad s_2 = 1 \]

\[ \frac{1+\gamma_1\mu}{2} \]

**Figure 2:** The manipulable range of the belief when \( s_1 = 1 \) 
\( (\mu = 0.5, \tilde{\gamma} = 0.5, \gamma_1 = 0.8) \).
As result of the conflict, DM ends up with some view of the world, which is represented by the information set $\Omega_t$:

$$\Omega_1 := (s_1, \gamma_1), \quad \Omega_2 := (s_1, s_2, \gamma_1, \gamma_2).$$
The choice of action

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- Being the only one to care about the outcome of the project, the objective self chooses the action in each period.

- The optimal action is chosen based on the compromised reality $\Omega_t$, so that $a_t = \text{prob}\{\theta = 1 \mid \Omega_t\}$, because deviating from this would yield cognitive dissonance.
The objective self’s payoff is the value of the project and given by

$$\pi^O_1(a_1; \gamma_1) = R(a_1, \tilde{\rho}_1) + \Pi^O_2(\gamma_1),$$

$$\pi^O_2(a_1, a_2; \gamma_1, \gamma_2) = R(a_2, \tilde{\rho}_2),$$

where $\Pi^O_2(\gamma_1)$ is the expected payoff in period 2.
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The subjective payoff is the current belief about her own ability type and given by

$$\pi^S_1(\gamma_1) = \mu_1(s_1; \gamma_1),$$

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Payoffs

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The overall payoff is \( \pi_t = \alpha \pi^S_t + (1 - \alpha) \pi^O_t \), where \( \alpha \in (0, 1) \) is the subjective self’s share.
By period 2, DM has observed two signals, which may or may not be consistent with each other.
The second-period problem

- By period 2, DM has observed two signals, which may or may not be consistent with each other.
- DM’s problem is defined as

\[
\max_{\gamma_2} \alpha \mu_2(s_1, s_2; \gamma_1, \gamma_2) + (1 - \alpha) R(\rho_2(s_1, s_2; \gamma_1, \gamma_2), \rho_2(s_1, s_2; \tilde{\gamma}, \tilde{\gamma})),
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taking \(\gamma_1\) as given.
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taking \(\gamma_1\) as given.
- If DM can subjectively assign the informativeness of the signal, what should she do?
Consistent signals are observed

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- The first-order condition is

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\frac{\alpha \gamma_1 \sigma^2}{(1 + \gamma_1 \gamma_2 \mu)^2} - (1 - \alpha)(\rho_2 - \tilde{\rho}_C) \frac{1 - (\gamma_1 \mu)^2}{(1 + \gamma_1 \gamma_2 \mu)^2} = 0.
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- DM tends to underreact to inconsistent information.
Suppose that \( s_1 = 1 \). The optimal bias in period 2 is always positive and given by

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\rho_2^* - \tilde{\rho}_2 = \frac{\beta \sigma^2 \gamma_1}{1 - (\gamma_1 \mu)^2}.
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The absolute size of the bias is increasing in \( \beta, \sigma^2, \mu \) and \( \gamma_1 \).
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Here, \( \beta := \alpha/(1 - \alpha) \) is a measure of DM’s willpower, where DM lacks willpower to regulate the subjective self when \( \beta \) is small.
The first-period problem

- By discounting the informativeness of the first signal, DM can better regulate the subjective self in period 2.
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Let $b_1^* := \rho_1 - \tilde{\rho}$ denote the optimal bias. The first-order condition is

$$b_1^* = R b_2^*, \text{ where } R := -\frac{2\beta \sigma^2 (1 + (\gamma_1 \mu)^2)}{\mu (1 - (\gamma_1 \mu)^2)^2}.$$
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The tradeoff is between the first-period loss and the second-period gain. Vision and flexibility are substitutes.
Proposition

Suppose that $s_1 = 1$. The optimal bias in period 1 is always negative. The absolute size of the bias is increasing in $\beta$ and $\sigma^2$, whereas it is decreasing in $\mu$ if

$$1 - 4(\tilde{\gamma}_\mu)^2 - 3(\tilde{\gamma}_\mu)^4 > 0.$$
Proposition

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- DM tends to underreact to early information, giving rise to the emergence of indecisiveness.
Both obsession and stubbornness are a manifestation of confirmatory bias, where a decision maker adheres excessively to prior information.
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Both obsession and stubbornness are a manifestation of confirmatory bias, where a decision maker adheres excessively to prior information. A decision maker with high self-confidence is more prone to this problem because the first signal is more reliable and the cost of biasing the interpretation of the second signal is relatively small. Rabin and Schrag (1999) and Compte and Postlewaite (2004) explore consequences of confirmatory bias. Here, we take a different approach, as we derive confirmatory bias rather than assuming it and exploring its consequences.
The lack of vision or decisiveness is a consequence of the self-control problem.
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A decision maker with low self-confidence is more prone to this problem because the first signal is less reliable and the cost of biasing the interpretation of the first signal is relatively small.
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Here, the self-control problem arises due to the difference in time horizon between the two selves.
Relation to other strands of literature

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- The paper is particularly related to PS where the fear of inconsistent information is the driving force.
- In PS, the agent exaggerates information when young and becomes conservative when old.
- Among several differences, the main difference is that we explicitly consider dynamic incentives.
We construct a model of intrapersonal conflicts between the divided selves to explore how information is processed over time.
Conclusion

- We construct a model of intrapersonal conflicts between the divided selves to explore how information is processed over time.
- Inflexibility, both ways, arises when the objective self compromises the subjective self in the process of information evaluation. This amounts to confirmatory bias as emphasized in the psychology literature.
Conclusion

- We construct a model of intrapersonal conflicts between the divided selves to explore how information is processed over time.
- Inflexibility, both ways, arises when the objective self compromises the subjective self in the process of information evaluation. This amounts to confirmatory bias as emphasized in the psychology literature.
- Indecisiveness arises as a consequence of an attempt to regulate the future self. The lack of willpower is the driving force.
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In general, a decision maker with high confidence exhibits less flexibility but more vision.