THE EVOLUTION OF UTILITY

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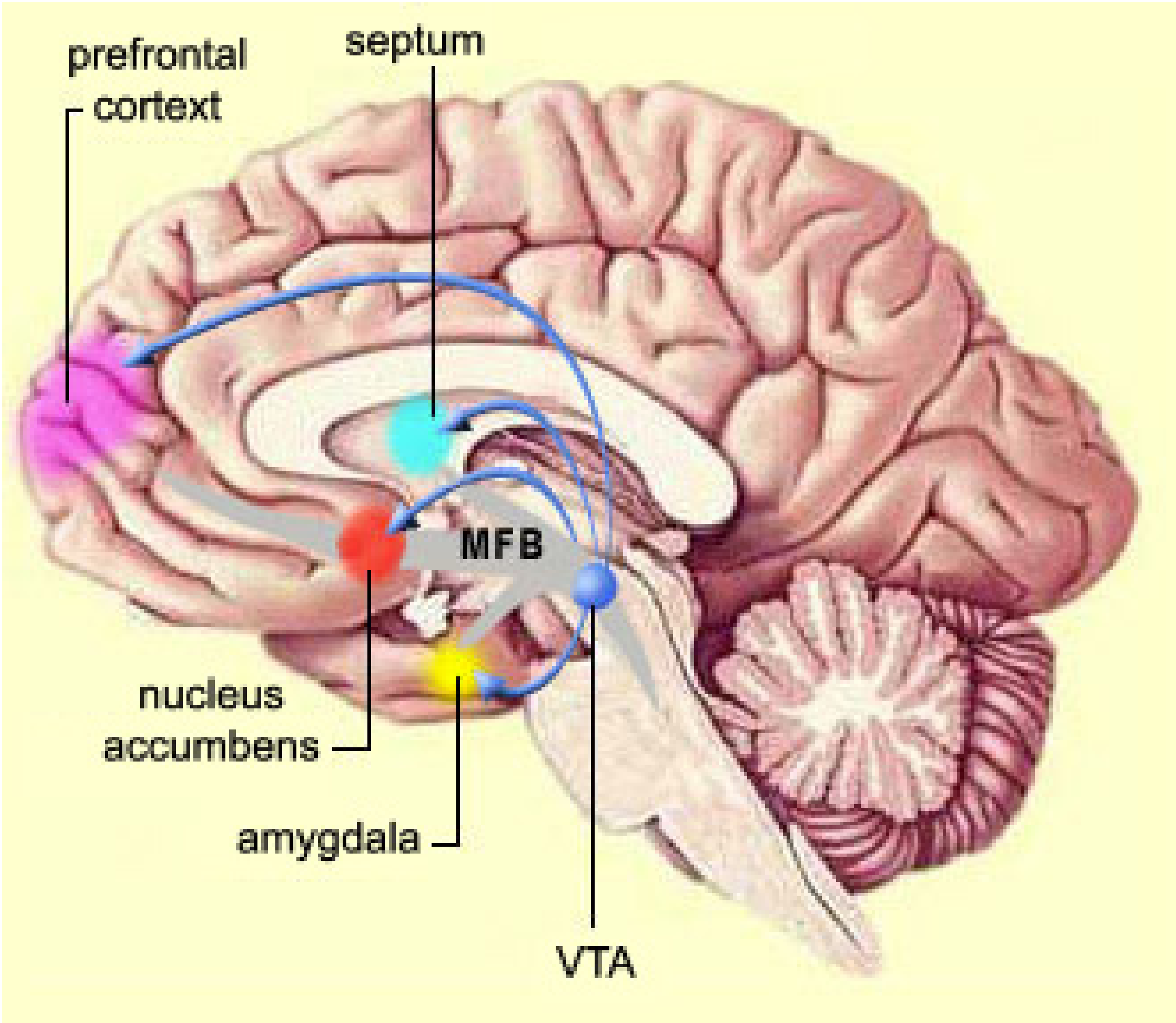
"Why Did Nature Give Us Utility Functions?" *Journal of Political Economy*, 2001

Principal-agent problem. Asymmetric information. Devolution.

HEDONIC UTILITY

Jeremy Bentham. "Greatest good for the greatest number"

Neurological basis of pleasure and its role in motivating individual behavior.



HEDONIC ADAPTATION

“The Biological Basis of Economic Behavior,” *Journal of Economic Literature*, 2001

Adaptation of hedonic utility is biologically optimal.

Rayo and Becker “Evolutionary Efficiency and Happiness” *Journal of Political Economy*, 2007

Bounds on hedonic utility. Limited discrimination.

Robson and Samuelson, “The Evolutionary Optimality of Decision and Experienced Utility,” *Theoretical Economics*, forthcoming

Optimality of the “focussing illusion.”

Schkade and Kahneman “Does living in California make people happy? A focusing illusion in judgments of life satisfaction,” *Psychological Science*, (1998)

Undergraduates at the University of Michigan who contemplate moving to California routinely report that they expect to be significantly happier there than they were in Michigan. But UCLA undergraduates claim to be no happier than the people in Michigan.

Winter surfing in Michigan-

-and in California (?)-

That is, people exhibit a "focussing illusion." This involves the distinction between *decision utility* and *experienced utility* made by Kahneman and Thaler (2006)).

"Nothing matters as much as you think." Gilbert "Stumbling on Happiness."

- Why would economists be interested in the difference between decision and experienced utility? From a hardline neoclassical point of view, decision utilities determine or describe choice, and we need consider no internal mental processes. Cf Gul and Pesendorfer "Mindless Economics."

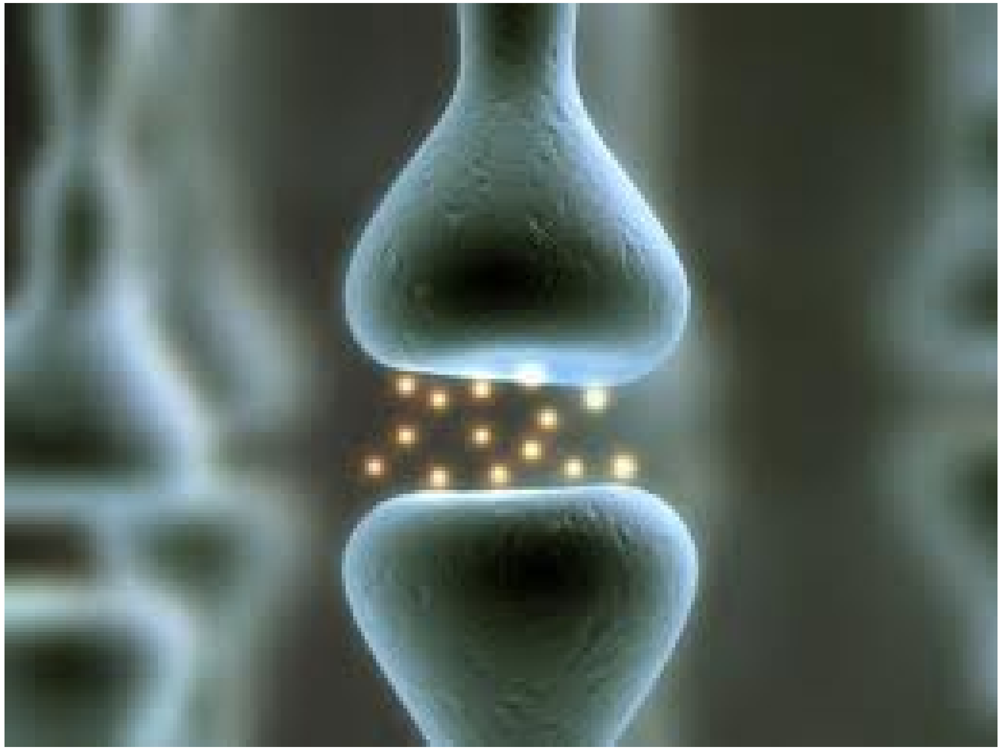
- We take the view that, although utility may NEED only be a ghostly concept, it IS in hard fact, hedonic.

We take a positive approach where evolution is a principal designing agents to make fitness-enhancing decisions.

- Why would we have different decision and experienced utilities? Why doesn't evolution simply tell us to maximize fitness?
- If there is a conflict between decision and experienced utilities, should we be unaware (naive) or aware (sophisticated) of this conflict (O'Donoghue and Rabin (1999))?
- Are economists really totally off base here?

The key features of our analysis are:

- Evolution must design utility functions for agents who make intertemporal choices.
- There are bounds on utilities. For evidence, see Simmons and Gallistel (1994).



- There are also limits to our ability to discriminate between different levels of utility.

- Therefore, a “steep” utility function works better. But it can only be steep “where it counts.” There is then adaptation.

- This adaptation means the focussing illusion arises.

- The agent should be naive.

- With fine discrimination, the focussing illusion remains, but the individual approximately satisfies revealed preference.

The Evolutionary Environment

Fitness is given over two periods by

$$\begin{aligned}\tilde{z} &= \tilde{z}_1 + \tilde{z}_2 \\ &= [f_1(x_1) + \tilde{s}_1] + [\gamma \tilde{z}_1 + f_2(x_2) + \tilde{s}_2].\end{aligned}$$

Nature maximizes the expected value of $\tilde{z}$. Choices are x_1 and x_2. The random variables $\tilde{s}_1$ and $\tilde{s}_2$ have single-humped distributions, with maximal humps at 0.

Nature designs utility to depend on z_1 and z_2. She cannot design utility to depend on x_1 and x_2; these variables, along with f_1 and f_2, are familiar only to the individual.

With no additional constraints, evolution could set

$$\begin{aligned} V_1(z) &= z \\ V_2(z|z_1) &= z. \end{aligned}$$

One constraint is that utilities are in $[0, 1]$. If that were all, could set

$$\begin{aligned} V_1(z) &= A + Bz \\ V_2(z|z_1) &= A + Bz. \end{aligned}$$

Additionally, however, the agent can only get within ε_i of maximal utility, in each period $i = 1, 2$.

The Second Period

Nature designs $V_2(z|z_1)$. This is labelled "experienced utility" but it is more basically also "decision utility."

Instead of choosing x_2^* to maximize $E_{\tilde{s}_2} V_2(z_1 + (\gamma z_1 + f_2(x_2) + \tilde{s}_2)|z_1)$ in the second period, the agent can only randomize over $[\underline{x}_2, \overline{x}_2]$, where $\underline{x}_2 < x_2^* < \overline{x}_2$ and

$$\begin{aligned} & E_{\tilde{s}_2} V_2((1+\gamma)z_1 + f_2(\underline{x}_2) + \tilde{s}_2|z_1) \\ = \quad & E_{\tilde{s}_2} V_2((1+\gamma)z_1 + f_2(\overline{x}_2) + \tilde{s}_2|z_1) \\ = \quad & E_{\tilde{s}_2} V_2((1+\gamma)z_1 + f_2(x_2^*) + \tilde{s}_2|z_1) - \varepsilon_2. \end{aligned}$$

Evolution chooses V_2 to maximize fitness, subject to these constraints.

The First Period

Nature designs "decision utility" $V_1(z) \in [0,1]$.

Take $\varepsilon_2 \to 0$ first. There is again a satisficing set $[\underline{x}_1, \overline{x}_1]$, where

$$\begin{aligned} & E_{\tilde{s}_1,\tilde{s}_2} V_1(f_1(\underline{x}_1) + \tilde{s}_1 + [\gamma(f_1(\underline{x}_1) + \tilde{s}_1) + f_2(x_2^*) + \tilde{s}_2]) \\ = \quad & E_{\tilde{s}_1,\tilde{s}_2} V_1(f_1(\overline{x}_1) + \tilde{s}_1 + [\gamma(f_1(\overline{x}_1) + \tilde{s}_1) + f_2(x_2^*) + \tilde{s}_2]) \\ = \quad & E_{\tilde{s}_1,\tilde{s}_2} V_1(f_1(x_1^*) + \tilde{s}_1 + [\gamma f_1(x_1^*) + \tilde{s}_1) + f_2(x_2^*) + \tilde{s}_2]) - \varepsilon_1. \end{aligned}$$

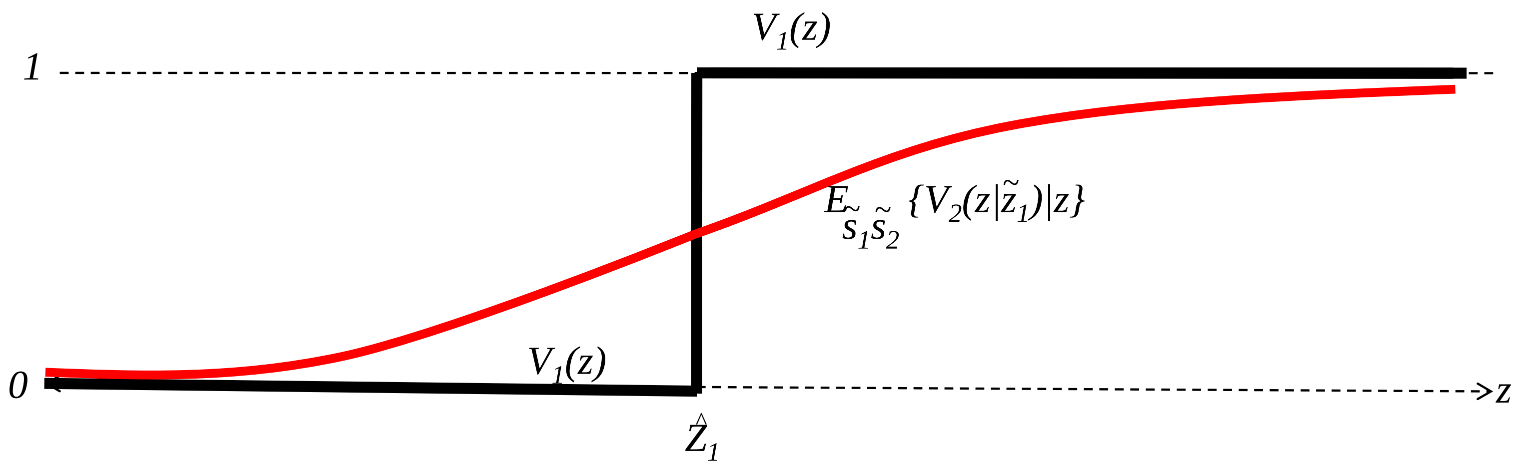
He randomizes uniformly over $[\underline{x}_1, \overline{x}_1]$. Evolution picks $V_1(z)$ to maximize expected fitness, subject to the above.

Altogether—

Proposition **1** *In the limit as the "utility-perception errors"* ε_2 *and then* ε_1 *approach zero, the optimal utility functions are*

$$\begin{aligned}
V_1(z) &= 0, \text{ for all } z < \hat{Z}_1 = (1+\gamma)f_1(x_1^*) + f_2(x_2^*) \\
V_1(z) &= 1, \text{ for all } z > \hat{Z}_1 = (1+\gamma)f_1(x_1^*) + f_2(x_2^*) \\
V_2(z|z_1) &= 0, \text{ for all } z < Z_2(z_1) = (1+\gamma)z_1 + f_2(x_2^*) \\
V_2(z|z_1) &= 1, \text{ for all } z > Z_2(z_1) = (1+\gamma)z_1 + f_2(x_2^*).
\end{aligned}$$

Comparing Decision and Experienced Utilities



Sophisticated Agents?

To dramatize, consider the no error case. Then

$$E_{\tilde{s}_1,\tilde{s}_2} V_2(\tilde{z}|\tilde{z}_1) = \Pr[\tilde{s}_2 \;\geq\; 0] = \frac{1}{2},$$

for *every* x_1.

Correctly anticipated experienced utility provides no incentives at all, while decision utility still does. With errors, it is strictly better for agents to be naive.

Implications

Given that utility has an evolutionary origin (and so is hedonic), there would be a distinction between decision and experienced utility. Psychologists are prone to go further, arguing that decisions would be improved if decision utility were replaced by expected experienced utility. Our model provides no support for this view. Decision and experienced utilities combine to produce fitness-maximizing choices. Early choices based on experienced utilities can only reduce fitness. The resulting choices will nevertheless be approximately rational, satisfying revealed-preference, with fitness as the true utility function, as long as the errors are small.

The End