# Disclaimer

- These slides are posted solely to accompany Matthew's lectures at the 2022 Russell Sage Summer Institute in Behavioral Economics.

- They are not edited carefully as stand-alone notes, and are not intended for general circulation.

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# Introduction to Limited Rationality

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1. It is obvious people are not 100% rational, and that they are not 100% in commonly occuring high-stakes settings.
2. And obvious that departures from 100% rationality matter.

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- Strange, frustrating aesthetic on cognition:
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  - OK to model as non-human machines or thoughtless lemmings.
  - It is just not okay to model them as humans.

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Proof of Claim 1:

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Proof of Claim 2:

- Billions of $ in direct educational costs and maybe trillions of $ on opportunity costs to teach math.

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- Given that our brains are not perfect, we make do with approximate heuristics; conserve energy, don’t pay infinite attention, etc.
- Identifying the source of “bounds” in bounded rationality does not magically make it unboundedly rational.
- We won’t emphasize the "theory-office neuro" that seeks to find the “foundations” of the human error as a constrained-maximization solution to structures that brains (are imagined to) have.

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But never use labeling to obfuscate:

- If consumers' unenthusiasm for detailed calculations to choose optimal phone contract is called rational, do not then study markets or policy as if consumers are "no-mistake rationals".

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  - Figuring out the right rule of thumb might be difficult.

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  - But then **literal correctness** may be lower.

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  - You are masters of probability theory and would not make errors when the probability theory is made salient ... but commit those errors in life.

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  - don't think about some choices, and don't integrate others.

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- All 3 Quasi-Max errors contribute.

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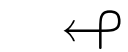

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- Apart from question of **how much she cares** about future utility... (present bias), question of **what she believes** about future utility.

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  - And if anticipation matters, can't depend on correctness.

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Language and Psychology:

- Misprediction vs. underappreciation:
  - Caveat to the language and formalization using here:
  - Is it really always a sort of "active misprediction" in the sense that people have articulated beliefs, but they get them wrong?

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Changing tastes are fact about utility, not an indication of irrationality.

- The fact that tastes change, while not regularly part of core economics, is utterly consistent with rational choice, and has been much studied in rational-choice models recently.

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10 domains of evidence so far (in increasing order of importance)

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- This turns out to be some of the best evidence.

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Despite *vast experience*, we underestimate these fluctuations.

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- Or planning diet right after stuffing your face/not dieting.
    - Not hungry now, so think can go the rest of your life without eating!

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- Identifying hypothsis:
  - "Unhealthy" more appealing when hungry.

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% of Subjects Choosing "Unhealthy" Snack

| | | Future Hunger | |
|---|---|---|---|
| | | Hungry | Satiated |
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- What does comparing the rows tell us?
  - Projection bias.

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- "Under-attendance-to" might be the right term.

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- Observe: always being asked about a *second* dose.

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Two rules of thumb:

- Don't follow normative advice from those descriptively wrong.
- If claim choice is error, must be **some** way to elicit what you believe is right choice.
- (Neither universal)

↬

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    - Decide before or after you've just done it?

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- **Difference between tasks chosen before and after completing mandatory work identifies $\alpha$.**

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- Completing supplemental work decision

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Overview of results:

- $\beta \in (0.812, 0.835)$
- $\beta_h \in (0.999, 1.014)$
- $\delta \in (1.003, 1.005)$

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Update ... Augenblick follow-up on 1-4 day delay ...

$\looparrowright$

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  - Note also: not a decrease over the weeks.

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Busse, Pope, Pope, and Russo: test for projection bias (PB) in housing and car market

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- We underestimate habit formation.

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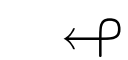

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Hint of evidence on habit formation (!), and of direct interest:

- Projection bias and Loss Aversion.

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- No data on non-winners' predictions of how they would feel if they won.
- But the notion that lottery winners are no happier than non-winners surely runs counter to the predictions of most people.
    - Including, presumably, those playing the lottery.
- Would people play if predicted full adaptation?

# Mispredicting Tastes

Classic study by Brickman, Coates, and Janoff-Bulman (1978):

- People underappreciate adaptation—winning lotteries, losing limbs.
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- Would people play if predicted full adaptation?
- Some suggestive stronger evidence:

↬

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Hint of evidence on adaptation, and of direct interest:

- Projection bias and Loss Aversion.

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- Then given mug, and form eliciting selling prices.
- Other half of subjects given mugs without first making predictions, then completed the form eliciting selling prices.

↩

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Question: What do the results indicate?

- Consistency indeed had some implications.

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- Next up: narrow bracketing makes people over-attentive to losses and gains, since don't think about how it will cancel out.
- Later: NBLLN.

# Mispredicting Tastes

(**Mugs Model worked out in posted slides**)

- Old-fashioned view of loss aversion as involving status quo, not expectations.
- Similar lessons surely hold if one models projection bias over belief-based preferences, but we have no formal models of that.
- In period $t$ a person can either "consume" a mug ($c_t = 1$) or not ($c_t = 0$).
- Person can either feel endowed with mug ($s_t = 1$) or feel unendowed with mug ($s_t = 0$).
- $s_t = c_{t-1}$

↬

# Mispredicting Tastes

In experiment:

- If the person decides to possess the mug, then $c_1 = c_2 = 1$.
- If decides not to possess the mug, then $c_1 = c_2 = 0$.

Both sellers and buyers choose between these two consumption flows

- But sellers feel endowed in period 1 — they have $s_1 = 1$.
- Buyers feel unendowed — they have $s_1 = 0$.
- If in period 1 the person chooses to possess the mug, she will feel endowed in period 2 — she'll have $s_2 = 1$.
- If in period 1 the person chooses not to possess the mug, she'll have $s_2 = 0$.

↬

# Mispredicting Tastes

True Utilities:

# Mispredicting Tastes

True Utilities:

| $u_t$(mug now?\| mug last period?) | | consumption u | | gain-loss u |
|---|---|---|---|---|
| $u_t$(y\|y) | = | 1 | + | 0 |
| $u_t$(n\|y) | = | 0 | + | -$\lambda k$ |
| $u_t$(y\|n) | = | 1 | + | $k$ |
| $u_t$(n\|n) | = | 0 | + | 0 |

where $y = 1$ and $n = 0$.
Perceived Utility: $\widetilde{U}^t = \sum_{\tau=t}^{\infty} \delta^\tau \tilde{u}(\mathbf{c}_\tau, \mathbf{s}_\tau | \mathbf{s}_t)$.

Consider the two extreme cases:

$$\alpha = 0 \Longrightarrow \textit{Rational expectations} \Longrightarrow \tilde{u}(\mathbf{c}_\tau, \mathbf{s}_\tau | \mathbf{s}_t) = u(\mathbf{c}_\tau, \mathbf{s}_\tau)$$

$$\alpha = 1 \Longrightarrow \textit{100\% projection bias.} \Longrightarrow \tilde{u}(\mathbf{c}_\tau, \mathbf{s}_\tau | \mathbf{s}_t) = u(\mathbf{c}_\tau, \mathbf{s}_t)$$

↬

# Mispredicting Tastes

Rational Buying Price:

- $B^{RAT} = u(y|n) - u(n|n) + \sum_{t=1}^{\infty} \delta^t [u(y|y) - u(n|n)]$
- $= 1 + k + \frac{\delta}{1-\delta}(1)$.

Rational Selling Price:

- $S^{RAT} = u(y|y) - u(n|y) + \sum_{t=1}^{\infty} \delta^t [u(y|y) - u(n|n)]$
- $= 1 + \lambda k + \frac{\delta}{1-\delta}(1)$.

So: $L^{RAT} \equiv \frac{S^{RAT}}{B^{RAT}} = \frac{1+\lambda k(1-\delta)}{1+k(1-\delta)} > 1$.

- Observe: $\frac{\partial L^{RAT}}{\partial \lambda} > 0$, $\frac{\partial L^{RAT}}{\partial k} > 0$, $\frac{\partial L^{RAT}}{\partial \delta} < 0$.
  - Interpret?
- Observe: $Lim_{\delta \longrightarrow 1} L^{RAT} = 1$.
  - Interpret?

↬

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Projection-Bias Prices (exercise: derive these):

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$$B^{PROJ} = u(y|n) - u(n|n) + \sum_{t=1}^{\infty} \delta^t [u(y|n) - u(n|n)] = 1 + k + \frac{\delta}{1-\delta}(1+k).$$

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Observe: $B^{PROJ} > B^{RAT}$, $S^{PROJ} > S^{RAT}$.

Observe: $L^{PROJ} \equiv \frac{S^{PROJ}}{B^{PROJ}} = \frac{1+\lambda k}{1+k}$.

Observe: $L^{PROJ} > L^{RAT}$.

So an interpretation of the evidence:

- Loss aversion rationally derive from real RD-VNM prefs, but by narrow bracketing and projection bias are irrationally magnified.

Can projection bias explain the Loewenstein and Adler stuff?

- We know $S^{PROJ} = \sum_{t=0}^{\infty} \delta^t [u(y|y) - u(n|y)] = \frac{1}{1-\delta}(1 + \lambda k)$.
- But what will be unendowed Person's Prediction, $E[S^{PROJ}|n]$?
- Claim: $E[S^{PROJ}|n] \equiv B^{PROJ}$ $(< S^{PROJ})$.

↩

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- Theobald is completely patient ($\delta \longrightarrow 1$) and will live forever.
- His utility each day $t$ is determined entirely by where he eats day $t$, $f_t \in \{a, b\}$, and where he ate yesterday, $f_{t-1} \in \{a, b\}$.

$\hookleftarrow$

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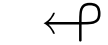
- Because that gives him average of $(5+9)/2 = 7$, rather than average of 6 if he always eats Austrian.



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  - Don't see through logic of how current behavior affects future utility.

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Accuracy may depend on current state of predicter, not their identity.

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- Most people have *some* awareness and sophistication.
- But still there is a big worry about underestimating these even when (as with hunger) there is a huge amount of past evidence.

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The role and power of habits may be massively underappreciated by economists ...

↩

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"The diminutive chain of habit is scarcely heavy enough to be felt till it is too strong to be broken."

— Samuel Johnson (simplification from 1800's temperance literature)

"The child is the Father of the Man."

— William Wordsworth

"The second half of a man's life is made up of nothing but the habits he has acquired during the first half."

— Feodor Dostoevsky

"Men's natures are alike; it is their habits that separate them."

— Confucius

"Nothing so needs reforming as other people's habits."

— Mark Twain

"My problem lies in reconciling my gross habits with my net income."

— Errol Flynn

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- *IF* consumption is more habit forming than leisure, may suggest that people excessively pursue wealth.
- Thinking lots more money forever will bring us lots more happiness forever. But we'll get used to it.

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- This is in part based on better attention to the psychology/sociology of well-being, and part on purported panel and cross sectional empirical evidence that growth does not seem to bring much happiness.
- (Research is on-going ... I believe non-adaptive models have exaggerated benefits of growth, but also very skeptical of over-strong claims doubting that money buys happiness.)

↩

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- But the third is especially compelling only if we posit some irrationality. If it is true that money doesn't buy happiness (for long), why would rational people work so hard to get more money?

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  - Especially excitement caused by "sales hype".
- Also random fluctuations in excitement
- Fully rational person would take decay into account.

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  - Buy when most excited $\longrightarrow$ too likely eventually buy

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  - Decreased incentives for sales hype to induce temporary excitement.

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# Mispredicting Tastes

**Revealed Preferences & Revealed Predictions of Preferences**

- We should not be in the business of condescendingly deciding what people's preferences 'ought' to be.
- Within reason, *De gustibus non est disputandum*
- But "within reason" matters ...
  - Attributing behavior to *functionally* insane 'utility maximization' rather than real mistakes is not humility, or anti-paternalism. It is far less insulting *and* far better science to attribute behavior to human mistakes than to inhuman preferences.

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How do we reveal potential misprediction of preferences? (Revealing certain types of statistical mistakes is in fact easier than this.)

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- Unless person dislikes \$, have revealed misprediction.

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- Other uncertainties and biases than projection bias.

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- Gained much more focus recent years.

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- But they are absolutely central for understanding risk preferences.

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- If merely reminding you of a possibility changes your choice?

$\hookleftarrow$

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Inconsistent with rational, broad bracketing of *any* preferences to behave risk-lovingly over modest stakes.

- Why make such a claim?
- If market for fair bets, you can always take a sure loss, and just try to go shopping for fair bets to get back risk.

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- This is **Decision Neglect**.

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- But raises challenges to models people have developed.

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- Experimenters bring into focus relevant pies to pay attention to, and the relevant set of people to split it among.
- But more generally in life such focus happens by accident, by the design of others, and occasionally by our own design.

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- Indirect—combine presumptive facts about "background noise" to argue calibrationally that observed choices are "too non-linear" to be consistent with integrating with unobserved other parts of life.
  - Note:"Indirect" shows simultaneously that people don't even narrowly bracket in as wise a way as they could.

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- Also, RW make clearer the "independence" of the two lotteries.

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  - Indication 1: same % as when choosing only 1 pair!

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- Clearly a mistake.

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- Much/**most** of what has been called NB or cousins (e.g., myopic loss aversion a la Benartzi and Thaler) may be rational news utility.
- But this form of narrow bracketing is (almost) surely an error.

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Slight reformulation (instructions make independence salient), scaled-down real stakes (paid 100% of time)

↩

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Decision (i): Choose between
A. sure gain of £2.40
B. 25% chance gain £10.00, 75% chance gain £0.00.

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Decision (i): Choose between
A. sure gain of £2.40
B. 25% chance gain £10.00, 75% chance gain £0.00.
Decision (ii): Choose between
C. sure loss of £7.50
D. 75% chance lose £10.00, 25% chance lose £0.00.

↩

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Results:

| | |
|---|---|
| $A$ and $C$ | 21% |
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So 28% choose the joint lottery

$$AD : (-\$7.60, 0.75; +\$2.40, 0.25)$$

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- All other examples, large-scale hypotheticals match PT better.

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- But:
  - I don't believe we'd see the same violations for large real stakes.

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Answer 2: in your face, and still don't integrate.

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- Claim is not that people are stupider than they have to be (but see below) given that they are subject to human constraints.
- Humans on average make the mistakes that humans on average make.
- The point is rather: people are less rational than economic models suppose, in ways that matter.

Answer 2: in your face, and still don't integrate.

- So we've learned something about how powerful it is.

↩

# Decision Neglect and Narrow Bracketing

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  - Almost surely is exhibited massively in non-campus life.

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- If take risk in range where less risk averse, but turn down same risk in range where more risk averse, could do better by flipping.

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$\hookleftarrow$

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An underestimate of variability of stock portfolio:

- 2% of time $\Delta \in [-.01\%, +.01\%]$ (uniform), 98% outside
  14% of time $\Delta \in [-.1\%, +.1\%]$ (uniform), 86% outside
  83% of time $\Delta \in [-1\%, +1\%]$ (bellish), 17% outside.

↩

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- Whatever modest-scale risk aversion appears not consistent with integrating these

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  - 50% chance 7.50 going to poorer guy!

↩

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  - $\frac{5}{6}$ bracket narrowly, $\frac{1}{6}$ bracket broadly.

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|---|---|---|---|
| Fully rational | | | (✓) |
| "Constrained optimal" | | | ✓ |
| plausible constrained-suboptimal | | (✓) | ✓ |
| Implausible errors | ✓ | ✓ | ✓ |

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- $\checkmark \equiv$ could explain most/all instances.
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# Decision Neglect and Narrow Bracketing

What combinations of preferences and types of mistakes could explain the general pattern of modest-scale risk non-neutrality we observe?

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End of aside...

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Is Fiona better off new coin or old?

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  - Making empirical claim that incentives to make right choices work is not same as saying incentives righteous even when they don't work.

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Good theories of mistakes will lead to re-invigoration of revealed preference as a powerful tool for identifying people's (mistakes and) well being.

↬

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- What if I told you $\{x, y, z\}$ was really $\{x, \{y, z\}\}$?

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- Yao is sophisticated, Ming not.

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- Compare to their abstract choices—we predict for Ming his "most revealed" is his least favorite!
- And neither chooses most preferred from $\{x, y, z\}$.
- But Hsu seems to prefer $x$.
- No idea what doctrinaire economist who disallows such observations would infer ... but see taste for $z$ despite non-implementation.

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  - Other examples: replacing it with a *strictly larger* non-triangle (e.g., facilitating commitment devices).
  - Mostly: "cautious paternalism", regulations that interfere very little with rationals, but help people making mistakes.
- Keep in mind, via habit formation, changed lives, huge amount of life outcomes determined $<$ age 18.

↬