Critique of Kahneman & Prospect Theory; Sample Test-I Problems from the Past

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Are Humans Rational?
9/25/17
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Elements of the Critique

• Overconfidence & Stock Picking
• Betting & Prospect Theory
• Auction for $100
• Paradigm:
  – *Logicist Agent-Based Economics* (LABE)
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Overconfidence & Stock Picking …
help a stranger suffering a seizure. They certainly believed the statistics they were shown, but the base rates did not influence their judgment of whether an individual they saw on the video would or would not help a stranger. Just as Nisbett and Borgida showed, people are often reluctant to infer the particular from the general.

Subjective confidence in a judgment is not a reasoned evaluation of the probability that this judgment is correct. Confidence is a feeling, which reflects the coherence of the information and the cognitive ease of processing it. It is wise to take admissions of uncertainty seriously, but declarations of high confidence mainly tell you that an individual has constructed a coherent story in his mind, not necessarily that the story is true.

The Illusion of Stock-Picking Skill

In 1984, Amos and I and our friend Richard Thaler visited a Wall Street firm. Our host, a senior investment manager, had invited us to discuss the role of judgment biases in investing. I knew so little about finance that I did not even know what to ask him, but I remember one exchange. “When you sell a stock,” I asked, “who buys it?” He answered with a wave in the vague direction of the window, indicating that he expected the buyer to be someone else very much like him. That was odd: What made one person buy and the other sell? What did the sellers think they knew that the buyers did not?

Since then, my questions about the stock market have hardened into a larger puzzle: a major industry appears to be built largely on an illusion of skill. Billions of shares are traded every day, with many people buying each stock and others selling it to them. It is not unusual for more than 100 million shares of a single stock to change hands in one day. Most of the buyers and sellers know that they have
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Simple as that.

Oh, & we have the counter-example of Jim Simons …
Medallion Fund

Renaissance's most famous portfolio, the Medallion fund, is considered to be one of the most successful hedge funds ever that has averaged a 71.8% annual return, before fees, from 1994 through mid-2014.[8] This fund is closed to outside investors since 1993 and is available only to current and past employees and their families. The firm bought out the last investor in the Medallion fund in 2005 and the investor community has not seen its returns since then.[7] About 100 of Renaissance's 275 or so employees are what it calls “qualified purchasers”, meaning they generally have at least $5 million in assets to invest. The remaining are "accredited investors", generally worth at least $1 million.[8]

"Since its inception in March 1988, Simons' flagship $3.3 billion Medallion fund, has amassed annual returns of 35.6 percent, compared with 17.9 percent for the Standard & Poor's 500 index. For the 11 full years ended December 1999, Medallion's cumulative returns are an eye-popping 2,478.6 percent. Among all offshore funds over that same period, according to the database run by veteran hedge fund observer Antoine Bernheim, the next-best performer was Soros' Quantum Fund, with a 1,710.1 percent return (see table, page 44). "Simons is No. 1," says Bernheim. "Ahead of George Soros. Ahead of Mark Kingdon. Ahead of Bruce Kovner. Ahead of Monroe Trout."

— "The Secret World of Jim Simons" 2000

By the year 2000, the computer-driven Medallion fund had made an average of 34% a year after fees since 1988.[13] The firm bought out the last investor in the Medallion fund in 2005 and the investor community has not seen its returns since then.[7] Simons ran Renaissance until his retirement in late 2009.[10] Since the firm bought out the last investor in the Medallion fund in 2005, there's no information on the fund's returns since then. Of the 148 months between January 1993 and April 2005, Medallion only had 17 monthly losses. Out of 49 quarters in the same time period, Medallion only posted three quarterly losses. Medallion had between 1993–2005 only one year showing a loss: 1989.[20]

Medallion as a retirement fund  [ edit ]

"[Renaissance] won the [Labor Department]'s permission to put pieces of Medallion inside Roth IRAs. That means no taxes -- ever -- on the future earnings of a fund that averaged a 71.8 percent annual return, before fees, from 1994 through mid-2014."

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$100 Auction …
LABE applied to? …
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• Formal Science of Science: Economics
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Formulae for Normal Auction

AA1. "It is common knowledge that at all times \( t \), agents \( a \), and bid amounts \( x \), agent \( a \) bids \( x+1 \) at time \( t+1 \) only if the current high bid is \( x \) at time \( t \) and \( a \) is not the current high bidder."

\[ \text{AA1: Assume} \]

\[ \forall t,a,x \ (\text{happens}(\text{action}(a,bids(x+1),t+1)) \rightarrow (\text{holds}(\text{high_bid}(x),t) \land \neg \text{holds}(\text{high_bidder}(a),t))) \]  

AA2. "It is common knowledge that at all times \( t \), agents \( a \), and bid amounts \( x \), \( a \) is the high bidder at time \( t \) if and only if \( a \) successfully bids \( x \) at time \( t \)."

\[ \text{AA2: Assume} \]

\[ \forall t,a,x \ (\text{holds}(\text{high_bidder}(a),t) \iff \text{happens}(\text{action}(a,bids(x),t))) \]  

AA3. "It is common knowledge that at all times \( t \), agents \( a \), and bid amounts \( x \), \( x \) is the high bid at time \( t \) if and only if \( a \) successfully bids \( x \) at time \( t \)."

\[ \text{AA3: Assume} \]

\[ \forall t,a,x \ (\text{holds}(\text{high_bid}(x),t) \iff \text{happens}(\text{action}(a,bids(x),t))) \]  

AA4. "It is common knowledge that there is no more than one high bidder at any time \( t \)."

\[ \text{AA4: Assume} \]

\[ \forall t,a,y \ (\text{holds}(\text{high_bidder}(a),t) \land y = a) \rightarrow \neg \text{holds}(\text{high_bidder}(y),t)) \]  

AA5. "It is common knowledge there is no more than one high bid at any time \( t \)."

\[ \text{AA5: Assume} \]

\[ \forall t,x,y \ (\text{holds}(\text{high_bid}(x),t) \land y = x) \rightarrow \neg \text{holds}(\text{high_bid}(y),t)) \]  

AA6. "At all times during the auction, if an agent makes a bid, then all agents perceive it; i.e., it's a public auction where all bidding is perceived by everyone."

\[ \text{AA6: Assume} \]

\[ \forall t,a,x,b \ (\text{happens}(\text{action}(a,bids(x),t)) \rightarrow \text{Pb}(\text{happens}(\text{action}(a,bids(x),t))) \]  

AA7. "It is common knowledge that for all times \( t \), all agents \( a \), and all bid amounts \( x \), \( a \) buys reward at time \( t+1 \) for price \( x \) if and only if \( a \) bids \( x \) at time \( t \) and there does not exist an agent \( b \ (b \neq a) \) who bids \( x+1 \) at time \( t+1 \)."

\[ \text{AA7: Assume} \]

\[ \forall t,a,x \ (\text{happens}(\text{action}(a,buys(price,x),t+1)) \iff (\text{happens}(\text{action}(a,bids(x),t)) \land \neg \exists b \ (b \neq a \land \text{happens}(\text{action}(b,bids(x+1),t+1)))) \]  

\[ \text{AA7: Assume} \]
Beliefs and Intentions (Strategy) for Normal Auction

B1. "Everyone believes the prize value is 20."
   {B1} Assume ✓

B2. ∀ a ∈ B(a, reward_value(20))
   {B2} Assume ✓

l1. "For all a, t, x, a makes a bid of x+1 at time t+1 if and only if a believes reward value is 20, a knows high bid is x, a is not high bidder, and a knows x + 1 <= 20."
   {l1} Assume ✓

l1. ∀ a, t, x ((B(a, reward_value(20)) ∧ K(a, holds(high_bid(x), t)) ∧ K(a, ¬ holds(high_bidder(a), t)) ∧ K(a, (x + 1 <= 20))) ↔ happens(action(a, bids(x + 1), t + 1)))
   {l1} Assume ✓
Bi-Pay Auction Formulae

in addition to those of the normal auction...

AA8. "It is common knowledge that for all \( t \) and all agents \( a \), \( a \) is second high bidder at time \( t+1 \) if and only if \( a \) was high bidder at time \( t \) and there exists \( b \) bids \( x+1 \) at \( t+1 \) \( (b <> a) \)."

\[
\text{AA8} \quad \text{Assume } \checkmark
\]

\[
\text{AA8. } C(\forall t, a \ (\text{holds(second_high_bidder}(a),t + 1) \leftrightarrow (\text{holds(high_bidder}(a),t) \wedge \exists b \ (\text{happens(action(bids(b,x + 1),t + 1))}) \wedge b <> a)))
\]

\[
\text{AA8} \quad \text{Assume } \checkmark
\]

AA9. "It is common knowledge that for all \( t \), bid amounts \( x \), \( x \) is second high bid at time \( t+1 \) if and only if \( x \) was high bid at time \( t \) and there exists agent \( a \) that bids \( x+1 \) at \( t+1 \)."

\[
\text{AA9} \quad \text{Assume } \checkmark
\]

\[
\text{AA9. } C(\forall t, x \ (\text{holds(second_high_bid(x),t + 1) } \leftrightarrow \text{holds(high_bid(x),t) } \wedge \exists a \ (\text{happens(action(bids(a,x + 1),t + 1))}))
\]

\[
\text{AA9} \quad \text{Assume } \checkmark
\]

AA10. "It is common knowledge that for all times \( t \), all agents \( a \), and all bids \( x \), \( a \) pays \( x \) at \( t+1 \) iff \( a \) is second high bidder at \( t \) and there is not an agent \( b \) \( (b <> a) \) who bids \( x+1 \) at \( t+1 \)."

\[
\text{AA10} \quad \text{Assume } \checkmark
\]

\[
\text{AA10. } C(\forall t,a,x \ (\text{happens(action(a,pays(x)),t + 1) } \leftrightarrow \text{holds(second_high_bidder}(a),t) \wedge \neg \exists b \ (b = a \wedge \text{happens(action(b,bids(x + 1),t + 1))))})
\]

\[
\text{AA10} \quad \text{Assume } \checkmark
\]
Beliefs and Intentions (Strategy) for Bi-Pay Auction

B1. "Everyone believes the prize value is 20."
[1] Assume ✓

[∀a B(a, reward_value(20))]
[1] Assume ✓

B2. "Every agent believes that every other agent would never bid any more than 20 at any time t."
[1] Assume ✓

[∀x,a,t,b (a ≠ b → B(a, happens(action(b, bids(x + 1)), t + 1) → (x + 1 ≤ 20)))]
[1] Assume ✓

I1. "For all a, t, x, if a believes reward value is 20, knows high bid is x, a is not high bidder, and a knows x ≤ 20, then a makes a bid of x+1 at time t+1."
[1] Assume ✓

[I1. ∀a,t,x (((B(a, reward_value(20)) ∧ K(a, holds(high_bid(x), t)) ∧ K(a, ¬ holds(high_bidder(a), t)) ∧ K(a, (x ≤ 20))) → happens(action(a, bids(x + 1)), t + 1))]
[1] Assume ✓

I2. "For all t, agents a, agents b (b ≠ a), and bids x, if, at time t, a is 2nd high bidder and high bid is x and a does not believe b will bid x+2 at t+2, then a will bid x+1 at t+1."
[1] Assume ✓

[I2. ∀a,t,x,b ((K(a, holds(second_high_bidder(a), t)) ∧ K(a, holds(high_bid(x), t)) ∧ ¬B(a, happens(action(b, bids(x + 2), t + 2))) ∧ b ≠ a) → happens(action(a, bids(y, x + 1)), t + 1))]
[1] Assume ✓
Bi-Pay Auction Proof Assertion

C8: a bid over $20 occurs.
Conclusions

• How will human-level agents behave in the deviant bi-pay auction?

  • Two cases:

    • If naïve:

      • Lacking the time to thoroughly determine the answer to the question of whether to participate in the bi-pay auction, they substitute the easier question of whether to participate in a normal auction ... and the answer is YES!

    • If sophisticated:

      • Gamble that others won’t participate and win auction with early (low) bid.
Implementation of These Conclusions
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Initial “Toddler Steps’’ for Roscas in the LABE Paradigm …
Start of “Sound” 4-Agent Rosca
Start of “Sound” 4-Agent Rosca
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Start of “Sound” 4-Agent Rosca
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But:
How do we predict agents that won’t default?
How do we encourage agents not to default?
"Ethics" Added …

**Syntax**

\[
S ::= \text{Object} \mid \text{Agent} \mid \text{Self} \mid \text{Agent} \mid \text{ActionType} \mid \text{Action} \mid \text{Event} \mid \text{Moment} \mid \text{Boolean} \mid \text{Fluent} \mid \text{Numeric}
\]

\[
\text{action} : \text{Agent} \times \text{ActionType} \rightarrow \text{Action}
\]

\[
\text{initially} : \text{Fluent} \rightarrow \text{Boolean}
\]

\[
\text{holds} : \text{Fluent} \times \text{Moment} \rightarrow \text{Boolean}
\]

\[
\text{happens} : \text{Event} \times \text{Moment} \rightarrow \text{Boolean}
\]

\[
\text{clipped} : \text{Moment} \times \text{Fluent} \times \text{Moment} \rightarrow \text{Boolean}
\]

\[
f ::= \text{initiates} : \text{Event} \times \text{Fluent} \times \text{Moment} \rightarrow \text{Boolean}
\]

\[
\text{terminates} : \text{Event} \times \text{Fluent} \times \text{Moment} \rightarrow \text{Boolean}
\]

\[
\text{prior} : \text{Moment} \times \text{Moment} \rightarrow \text{Boolean}
\]

\[
\text{interval} : \text{Moment} \times \text{Boolean}
\]

\[
* : \text{Agent} \rightarrow \text{Self}
\]

\[
\text{payoff} : \text{Agent} \times \text{ActionType} \times \text{Moment} \rightarrow \text{Numeric}
\]

\[
t ::= x : S \mid c : S \mid f(t_1, \ldots, t_n)
\]

\[
t : \text{Boolean} \mid \neg \phi \mid \phi \land \psi \mid \phi \lor \psi
\]

\[
P(a,t,\phi) \mid K(a,t,\phi) \mid C(t,\phi) \mid S(a,b,t,\phi) \mid S(a,t,\phi)
\]

\[
\phi ::= B(a,t,\phi) \mid D(a,t,\text{holds}(f,t')) \mid I(a,t,\text{happens}(\text{action}(a^*,\alpha),t'))
\]

\[
O(a,t,\phi,\text{happens}(\text{action}(a^*,\alpha),t'))
\]

\[
S(s,h,t,\phi)
\]

\[
P(h,t,B(s,t,\phi))
\]

\[
I(a,t,\text{happens}(\text{action}(a^*,\alpha),t'))
\]

\[
P(a,t,\text{happens}(\text{action}(a^*,\alpha),t))
\]

\[
B(a,t,\phi) \mid B(a,t,O(a^*,t,\phi,\text{happens}(\text{action}(a^*,\alpha),t')))
\]

\[
O(a,t,\phi,\text{happens}(\text{action}(a^*,\alpha),t'))
\]

\[
K(a,t,I(a^*,t,\text{happens}(\text{action}(a^*,\alpha),t')))
\]

\[
\phi \leftrightarrow \psi
\]

\[
O(a,t,\phi,\gamma) \leftrightarrow O(a,t,\psi,\gamma)
\]

**Rules of Inference**

\[
C(t,P(a,t,\phi) \rightarrow K(a,t,\phi)) \quad [R_1] \quad C(t,K(a,t,\phi) \rightarrow B(a,t,\phi)) \quad [R_2]
\]

\[
C(t,\phi) \mid t \leq t_1 \ldots \leq t_n \quad [R_3]
\]

\[
K(a_1,t_1,\ldots,K(a_n,t_n,\phi)) \quad [R_4]
\]

\[
C(t,K(a,t_1,\phi_1) \rightarrow \phi_2) \rightarrow K(a,t_2,\phi_1) \rightarrow K(a,t_3,\phi_2) \quad [R_5]
\]

\[
C(t,B(a,t_1,\phi_1) \rightarrow \phi_2) \rightarrow B(a,t_2,\phi_1) \rightarrow B(a,t_3,\phi_2) \quad [R_6]
\]

\[
C(t,C(t_1,\phi_1) \rightarrow \phi_2) \rightarrow C(t_2,\phi_1) \rightarrow C(t_3,\phi_2) \quad [R_7]
\]

\[
C(t,\forall x. \phi \rightarrow \phi[x \mapsto t]) \quad [R_8]
\]

\[
C(t,\phi_1 \leftrightarrow \phi_2 \rightarrow \neg \phi_2 \rightarrow \neg \phi_1) \quad [R_9]
\]

\[
C(t,[\phi_1 \land \ldots \land \phi_n \rightarrow \phi] \rightarrow [\phi_1 \rightarrow \ldots \rightarrow \phi_n \rightarrow \psi]) \quad [R_{10}]
\]

\[
B(a,t,\phi) \rightarrow \psi \quad [R_{11a}]
\]

\[
B(a,t,\psi) \quad [R_{11b}]
\]

\[
B(a,t,\psi \land \phi) \quad [R_{11b}]
\]

\[
S(s,h,t,\phi) \quad [R_{12}]
\]

\[
I(a,t,\text{happens}(\text{action}(a^*,\alpha),t')) \quad [R_{13}]
\]

\[
P(a,t,\text{happens}(\text{action}(a^*,\alpha),t)) \quad [R_{13}]
\]

\[
B(a,t,\phi) \mid B(a,t,O(a^*,t,\phi,\text{happens}(\text{action}(a^*,\alpha),t')))
\]

\[
O(a,t,\phi,\text{happens}(\text{action}(a^*,\alpha),t')) \quad [R_{14}]
\]

\[
K(a,t,I(a^*,t,\text{happens}(\text{action}(a^*,\alpha),t')))
\]

\[
\phi \leftrightarrow \psi \quad [R_{15}]
\]

\[
O(a,t,\phi,\gamma) \leftrightarrow O(a,t,\psi,\gamma)
\]
“Ethics” Added ...

Syntax

\[ S ::= \]

Object | Agent | Self | Agent | ActionType | Action | Event | Moment | Boolean | Fluent | Numeric

\[ action : Agent \times ActionType \rightarrow Action \]

\[ initially : Fluent \rightarrow Boolean \]

\[ holds : Fluent \times Moment \rightarrow Boolean \]

\[ happens : Event \times Moment \rightarrow Boolean \]

\[ clipped : Moment \times Fluent \times Moment \rightarrow Boolean \]

\[ f ::= \]

\[ \text{initiates} : Event \times Fluent \times Moment \rightarrow Boolean \]

\[ \text{terminates} : Event \times Fluent \times Moment \rightarrow Boolean \]

\[ \text{prior} : Moment \times Moment \rightarrow Boolean \]

\[ \text{interval} : Moment \times Boolean \]

\[ * : Agent \rightarrow Self \]

\[ \text{payoff} : Agent \times ActionType \times Moment \rightarrow Numeric \]

\[ t ::= x : S \mid c : S \mid f(t_1, \ldots, t_n) \]

\[ t : Boolean \mid \neg \phi \mid \phi \land \psi \mid \phi \lor \psi \mid \]

\[ P(a,t,\phi) \mid K(a,t,\phi) \mid C(t,\phi) \mid S(a,b,t,\phi) \mid S(a,t,\phi) \]

\[ \phi ::= \]

\[ B(a,t,\phi) \mid D(a,t,\text{holds}(f,t')) \mid I(a,t,\text{happens}(action(a^*,\alpha),t')) \]

\[ O(a,t,\phi,\text{happens}(action(a^*,\alpha),t')) \]

Rules of Inference

\[ \frac{C(t,P(a,t,\phi) \rightarrow K(a,t,\phi))}{[R_1]} \]

\[ \frac{C(t,K(a,t,\phi) \rightarrow B(a,t,\phi))}{[R_2]} \]

\[ \frac{C(t,\phi) t \leq t_1 \ldots t \leq t_n}{[R_3]} \]

\[ \frac{K(a_1,t_1,\ldots K(a_n,t_n,\phi))}{[R_4]} \]

\[ \frac{C(t,K(a,t_1,\phi_1 \rightarrow \phi_2)) \rightarrow K(a,t_2,\phi_1) \rightarrow K(a,t_3,\phi_2)}{[R_5]} \]

\[ \frac{C(t,B(a,t_1,\phi_1 \rightarrow \phi_2)) \rightarrow B(a,t_2,\phi_1) \rightarrow B(a,t_3,\phi_2)}{[R_6]} \]

\[ \frac{C(t,C(t_1,\phi_1 \rightarrow \phi_2)) \rightarrow C(t_2,\phi_1) \rightarrow C(t_3,\phi_2)}{[R_7]} \]

\[ \frac{C(t,\forall x. \phi \rightarrow \phi[x \mapsto t])}{[R_8]} \]

\[ \frac{C(t,\phi_1 \leftrightarrow \phi_2 \rightarrow \neg \phi_2 \rightarrow \neg \phi_1)}{[R_9]} \]

\[ \frac{C(t,[\phi_1 \land \ldots \land \phi_n \rightarrow \phi] \rightarrow [\phi_1 \rightarrow \ldots \rightarrow \phi_n \rightarrow \psi])}{[R_{10}]} \]

\[ \frac{B(a,t,\phi) \rightarrow \psi}{[R_{11a}] B(a,t,\psi) \frac{B(a,t,\phi) B(a,t,\psi)}{[R_{11b}] B(a,t,\psi \land \phi)} \}

\[ S(s,h,t,\phi) \frac{B(s,h,B(s,t,\phi))}{[R_{12}] \]

\[ I(a,t,\text{happens}(action(a^*,\alpha),t')) \frac{P(a,t,\text{happens}(action(a^*,\alpha),t))}{[R_{13}] \]

\[ B(a,t,\phi) \frac{B(a,t,\psi \land \phi)}{[R_{14}]} \]

\[ O(a,t,\phi,\text{happens}(action(a^*,\alpha),t')) \frac{K(a,t,I(a^*,t,\text{happens}(action(a^*,\alpha),t')))}{[R_{14}] \]

\[ \phi \leftrightarrow \psi \frac{\phi \leftrightarrow \psi}{[R_{15}]} \]

\[ O(a,t,\phi,\gamma) \leftrightarrow O(a,t,\psi,\gamma) \]
“Ethics” Added …

Rules of Inference

$$\begin{align*}
\text{P}(a,t,\phi) & \rightarrow \text{K}(a,t,\phi) & [R_1] \\
\text{K}(a,t,\phi) & \rightarrow \text{B}(a,t,\phi) & [R_2] \\
\text{C}(t,\text{P}(a,t,\phi) & \rightarrow \text{K}(a,t,\phi)) & [R_3] \\
\text{K}(a,t,\phi) & \leq t_1 \ldots \leq t_n & [R_4] \\
\text{K}(a_1,t_1,\ldots,\text{K}(a_n,t_n,\phi)) & \rightarrow \text{K}(a,t,\phi) & [R_5] \\
\text{C}(t,\text{B}(a,t,\phi_1 & \rightarrow \phi_2)) & \rightarrow \text{K}(a,t,\phi_1) & \rightarrow \text{K}(a,t,\phi_2) & [R_6] \\
\text{C}(t,\text{B}(a,t_1,\phi_1 & \rightarrow \phi_2)) & \rightarrow \text{B}(a,t_2,\phi_1) & \rightarrow \text{B}(a,t_3,\phi_2) & [R_7] \\
\text{C}(t,\text{C}(t_1,\phi_1 & \rightarrow \phi_2)) & \rightarrow \text{C}(t_2,\phi_1) & \rightarrow \text{C}(t_3,\phi_2) & [R_8] \\
\text{C}(t,\forall x.\phi & \rightarrow \phi[x \leftarrow t]) & [R_9] \\
\text{C}(t,\phi_1 & \rightarrow \phi_2 \rightarrow \neg \phi_2 & \rightarrow \neg \phi_1) & [R_{10}] \\
\text{B}(a,t,\phi) & \rightarrow \psi & [R_{11a}] \\
\text{B}(a,t,\psi) & \rightarrow \text{B}(a,t,\psi & \land \phi) & [R_{11b}] \\
\text{S}(s,h,t,\phi) & \rightarrow \text{B}(h,t,\text{B}(s,t,\phi)) & [R_{12}] \\
\text{I}(a,t,\text{happens}(\text{action}(a^*,\alpha),t')) & [R_{13}] \\
\text{P}(a,t,\text{happens}(\text{action}(a^*,\alpha),t)) & \rightarrow \text{B}(a,t,\phi) & \rightarrow \text{B}(a,t,\phi & \land \phi) & [R_{14}] \\
\text{O}(a,t,\phi,\text{happens}(\text{action}(a^*,\alpha),t')) & \rightarrow \text{K}(a,t,\text{I}(a^*,t,\phi & \land \text{happens}(\text{action}(a^*,\alpha),t')) & [R_{15}] \\
\phi & \leftarrow \psi & [R_{16}] \\
\text{O}(a,t,\phi,\gamma) & \leftrightarrow \text{O}(a,t,\psi,\gamma) & [R_{17}] \\
\end{align*}$$
One of the four agents who wins the pot early knows that he will not refuse to ante up in subsequent periods, because he knows that he is obligated to refrain from dropping out, and intends to meet all obligations.

The system knows that one of the four agents who wins the pot early knows that he will not refuse to ante up in subsequent periods, because the system knows that that agents knows that he is obligated to refrain from dropping out …
One of the four agents who wins the pot early knows that he will not refuse to ante up in subsequent periods, because he knows that he is obligated to refrain from dropping out, and intends to meet all obligations.

The system knows that one of the four agents who wins the pot early knows that he will not refuse to ante up in subsequent periods, because the system knows that that agents knows that he is obligated to refrain from dropping out …
One Proof from Two POVs

One of the four agents who wins the pot early knows that he will not refuse to ante up in subsequent periods, because he knows that he is obligated to refrain from dropping out, and intends to meet all obligations.

The system knows that one of the four agents who wins the pot early knows that he will not refuse to ante up in subsequent periods, because the system knows that that agents knows that he is obligated to refrain from dropping out …
Sample Test 1 Problems …

(Back tests with solutions also available at: http://kryten.mm.rpi.edu/COURSES/AHR/ahr.html#sec-2.)
The Meaning of Life (Oct 2) …

• Kahneman Chapter 38: “Thinking About Life”
• SEP entry:
  • http://plato.stanford.edu/entries/life-meaning
    • Nozick’s Argument (I will cover & provide quotes)
    • Camus: The Myth of Sisyphus; Ecclesiastes
• The Brain & the Meaning of Life by Thagard, reviewed by Bringsjord & Bringsjord