Reconsidering Risk Aversion

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August 24, 2016

We are grateful to NIH/NIA for financial support (R21-AG037741, R01-AG040787, R01-AG020717-07, P01-AG026571, T32-AG00186), and to Mike Gideon for helpful early conversations.

Motivation

- Longstanding concern that Americans may not be investing appropriately for retirement. (e.g., Benartzi and Thaler, 1999)
  - May want to give advice about asset allocation.
  - Or use policy tools, such as defaults.
- "Good" asset allocation for an individual depends on risk aversion.
- Usual approach to measuring: infer from real or hypothetical choices.
- But such untutored choices may not accurately reflect preferences:
  - Investment choices themselves are the cause of concern.
  - Even simplified gambles unfamiliar and cognitively challenging.
  - Often violate seemingly compelling axioms of expected utility (EU).
    - Models of non-EU behavior are descriptive, and consistent with pref. *or* systematic-mistake interpretation.
      (e.g., Beshears et al., 2008; Bernheim and Rangel, 2009)
- How to measure individual's risk aversion for normative purposes?

This Paper

- We develop a two-stage survey procedure to measure risk aversion:
  1. Untutored choices: Standard elicitation of choices over risky lotteries.
  2. Reconsidered choices:
     a. We confront participants with *inconsistencies* in their untutored choices (i.e., framing effects) .
        - Different behavior when the "same" choice (according to standard axioms) is framed differently.
     b. We ask participants whether their untutored choices were mistaken, and if so, how they would like to revise.
- Major potential concern: experimenter demand effects.
  - We address in a range of ways, discussed later.
- We demonstrate our procedure in a sample of 601 Cornell students.
  - Make hypothetical choices about investing for retirement.

Our Key Assumption

- Our key assumption: Reconsidered choices more closely reflect the individual's true preferences.
  - Substantive psychological assumption; does not follow from principle of revealed preferences. (Bernheim and Rangel, 2009)
  - Builds on ancient tradition in moral philosophy and more recent tradition in decision analysis. (e.g., Raiffa, 1968)
    - Discover own preferences by identifying and resolving internal inconsistencies.
  - This assumption underlies a traditional defense of EU axioms as normative. (e.g., Morgenstern, 1979)
  - Most reasonable for abstract choices in deliberative state of mind. (cf. Giné, Goldberg, Silverman, and Yang, 2016)
- Under this assumption:
  - Can identify mistakes separately from deliberate axiom violations.
  - Can get better measure of risk aversion for normative purposes.

Related Literature

- Compare choices in risky lottery framed as "lives saved," "lives lost," or both frames together. (McNeil, Pauker, and Tversky, 1988; Druckman, 2001)
  - Risk averse in gain frame, risk-seeking in loss frame.
  - With both frames together, behavior is intermediate.
  - McNeil et al.: the mixed frame may be helpful because it calls attention to both positive and negative aspects of the outcomes.
- When provided with arguments for and against expected discounted value (EDV) of cash flows, participants more likely to maximize EDV. (Loewenstein and Sicherman, 1991)
- Measure "financial competence" as discrepancy in investment choices across frames. (Ambuehl, Bernheim, and Lusardi, 2016)
- Our paper builds on and differs from prior work in:
  - Prompting people to reconsider their own inconsistent choices and introspect about their reasons.
  - Systematically examining endorsement of a range of axioms comprising EU.

Outline

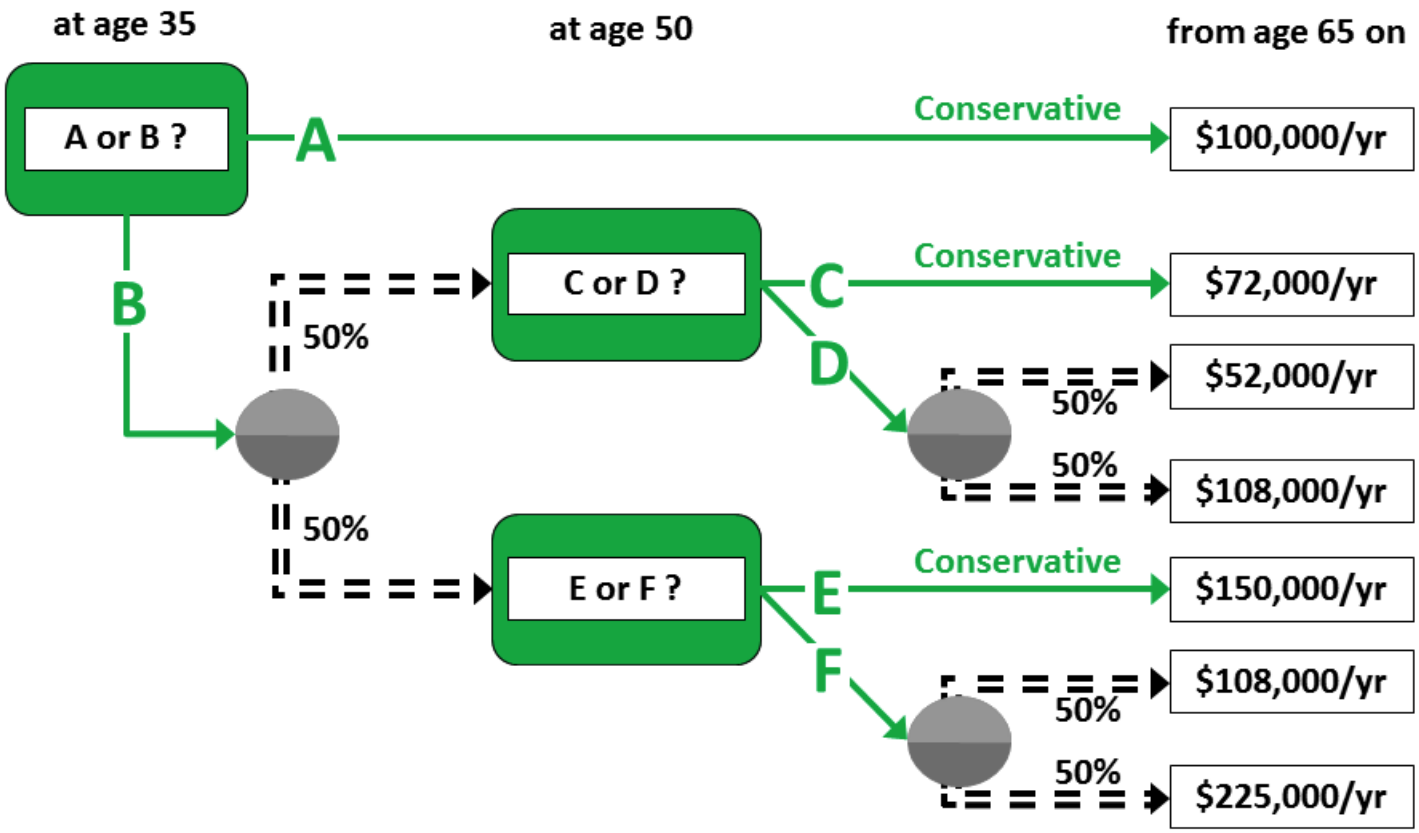
1. Introduction
2. ***Experiment Sample and Set-Up***
3. Results
4. Conclusion

Sample

- 601 Cornell subject pool participants: 90% undergrads, 65% female.
- Sessions scheduled for 2 hours.
- Mean survey completion time: 68 minutes.
- Paid $40 for participation.
- Of Wave 1+2 sample, 87% (*N* = 246) returned for wave 2.

Sample	**Dates**	***N***	**Differences**
Wave 1 sample	Jul-Dec 2013	317	Questions about why a person updated choices as they did were open-ended.
Wave 1+2 sample	Apr-May 2014	284	Questions about why a person updated as they did were multiple choice. Invited back for a 2nd wave.

Master Decision Tree for Risky Choices



- 5 possible plans: A, BCE, BCF, BDE, BDF (safest to riskiest by CRRA)

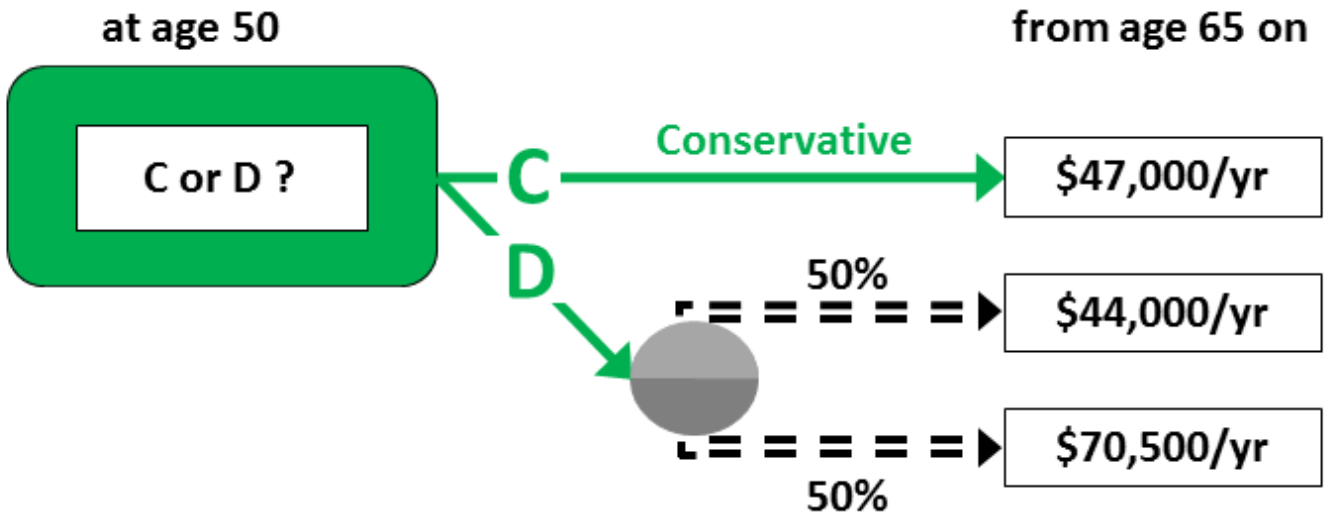
Experiment Flow

- Pre-test
- Training
  - Reviewed basic rules of probability
  - Taught symbols and figures
  - Reviewed background assumptions for choices
  - Could not continue until passed each quiz
- Main Body
  1. Untutored risky choices
  2. Reconsidered risky choices
     - Inconsistency reconsiderations
     - Intransitivity reconsiderations
- Personality and cognitive batteries
- Post-experiment questionnaire

Frames and Axioms

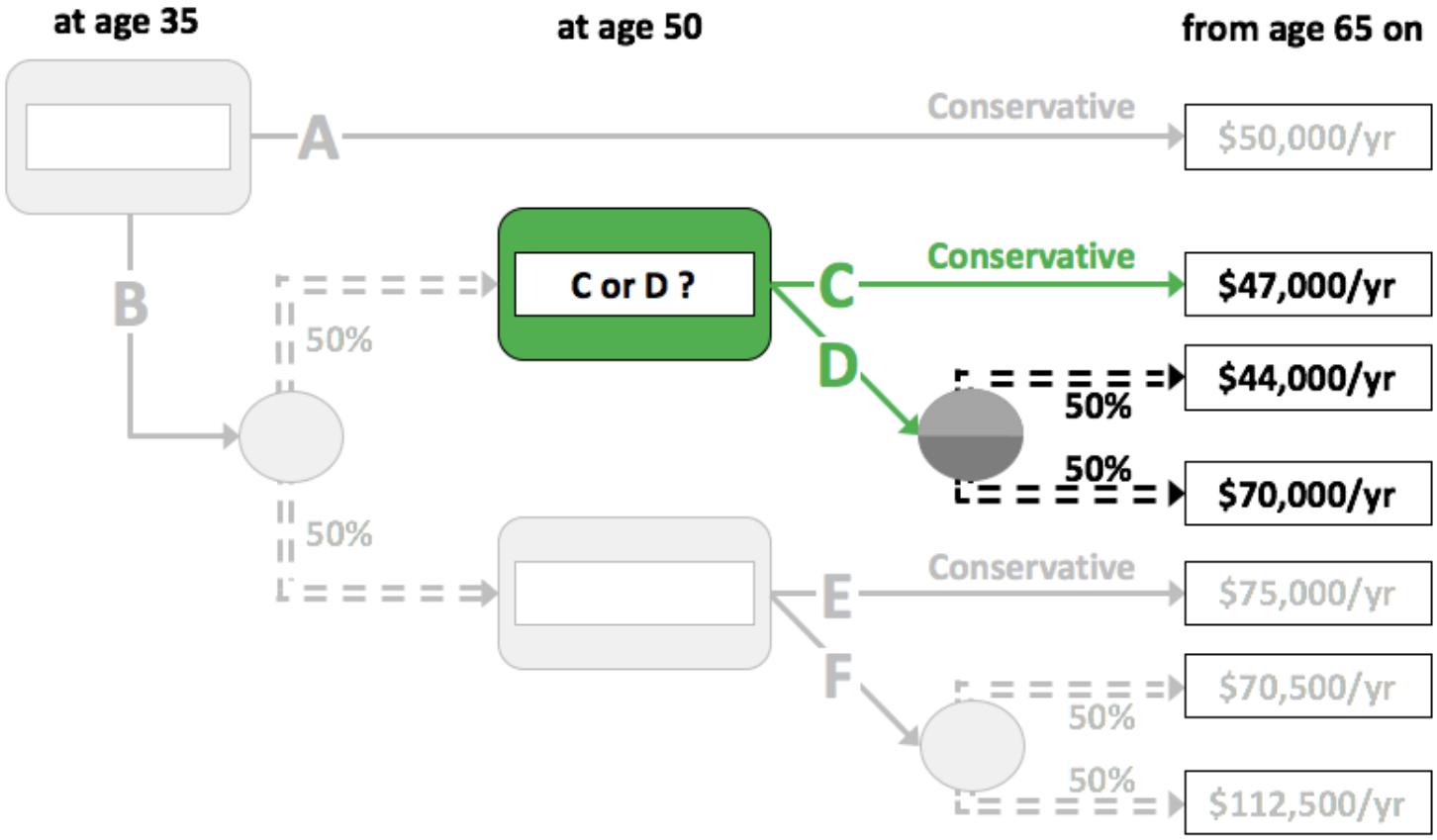
- 36 risky choices derived from the master decision tree.
  - Choices between the 5 investment plans framed 7 ways.

Frame: Single Action in Isolation



Note: 2 such questions (C vs. D and E vs. F).

Frame: Single Action with Backdrop



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Frames and Axioms

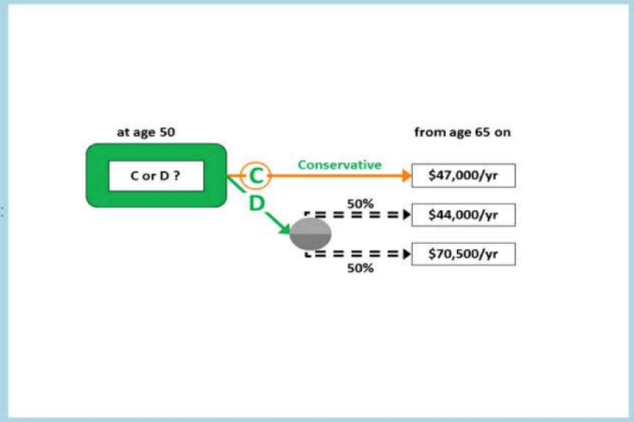
- 36 risky choices derived from the master decision tree.
  - Choices between the 5 investment plans framed 7 ways.
- Frames chosen such that:
  - Adjacent frames define a normative axiom (according to which the "same" choice should be made across frames).
  - Argument for equivalence across adjacent frames is self-evident.

Axiom: Irrelevance of Background Counterfactuals

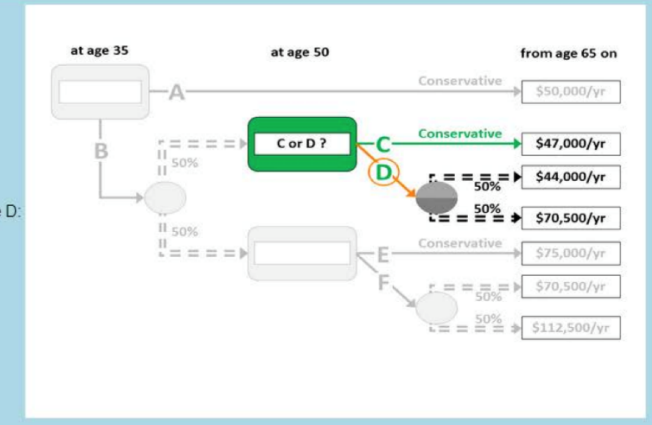
In one question you chose C over D, but in another question you chose D over C.

Do you think the two situations are different enough that it makes sense to have different choices, or should they be the same?

You chose C:



You chose D:



- It makes sense to have the same choice in both questions.
- It makes sense to have different choices.

Next >>

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  - Axioms: implicit in setup of EU, Reduction of Compound Lotteries, or "baby step" components of the Independence Axiom.
  - Consequently, participants never asked to understand a complex chain of reasoning.

List of Frames and Axioms

(Normative) Axiom	Frame 1	Frame 2
Irrelevance of Background Counterfactuals	Single Action in Isolation [2]	Single Action with Backdrop
Simple Actions = State-Contingent Actions	Single Action with Backdrop [2]	Two Contingent Actions with Backdrop
Irrelevance of Counterfactual Choices	Two Contingent Actions with Backdrop [1]	Complete Contingent Action Plan
Fusion + Shift from Nodewise to Pairwise	Complete Contingent Action Plan [1]	Pairwise Choices Between Complete Strategies
Complete Strategies = Implied Lotteries	Pairwise Choices Between Complete Strategies [10]	Pairwise Choices Between Compound Lotteries
Reduction of Compound Lotteries	Pairwise Choices Between Compound Lotteries [10]	Pairwise Choices Between Reduced Simple Lotteries [10]

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  - Axioms: implicit in setup of EU, Reduction of Compound Lotteries, or "baby step" components of the Independence Axiom.
  - Consequently, participants never asked to understand a complex chain of reasoning.
- In addition to Indep. Axiom sub-axioms, we study transitivity axiom.

Reconsideration Phase

- "Our research project depends on understanding your choices in a deep way. Now, we're going to ask you about some of the choices you've made so far."

- Algorithm:
  1. Inconsistencies: all current inconsistencies + ¼ of the consistent choices (placebos), randomly selected. (~5+5 total.)
     a. Ask whether or not they want to update one or both choices.
     b. Ask why they did or did not update.
  2. Intransitivities: all current pairwise-frame choices. (~1 total.)

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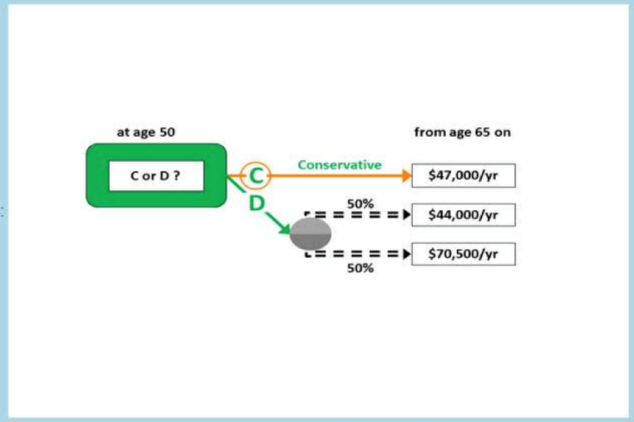
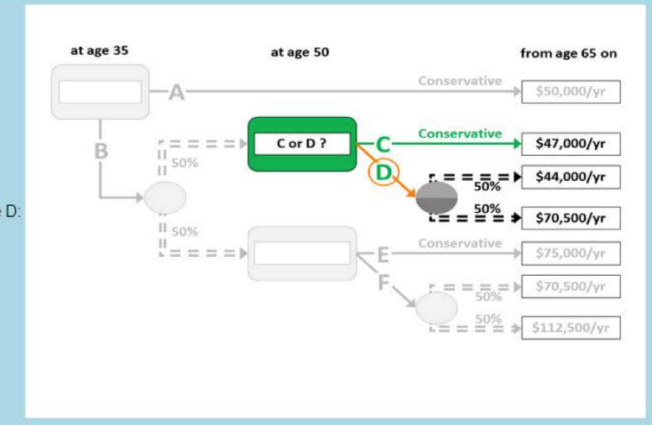


You chose D:



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Next >>

Inconsistencies and Placebo Inconsistencies

- Inconsistencies:

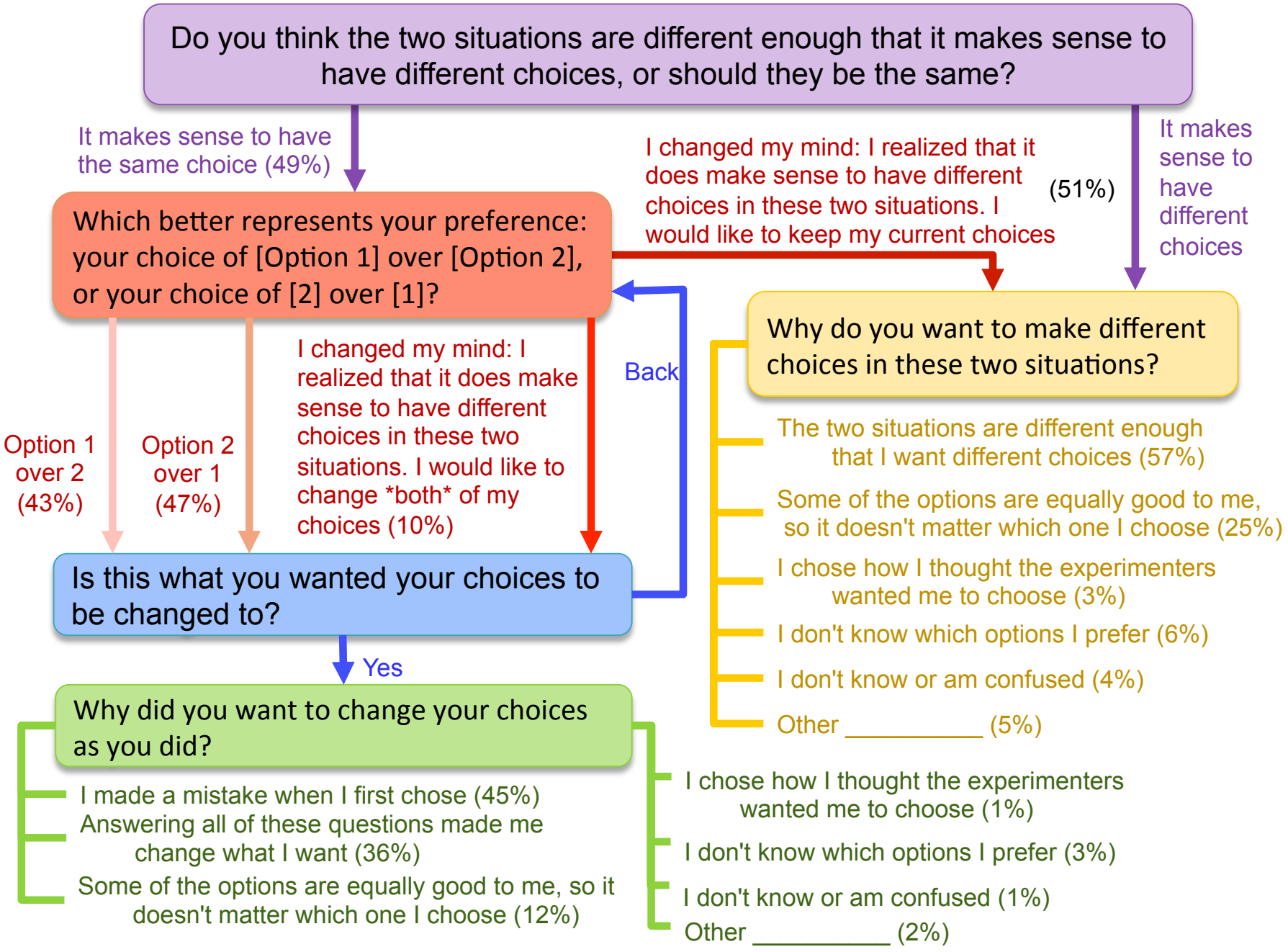
"In one question you chose C over D, but in another question you chose D over C.

Do you think the two situations are different enough that it makes sense to have different choices, or should they be the same?"

- Placebo inconsistencies:

"In these two questions, you chose C over D.

Do you think the two situations are different enough that it makes sense to have different choices, or should they be the same?"


Do you think the two situations are different enough that it makes sense to have different choices, or should they be the same?
It makes sense to have the same choice (49%)
I changed my mind: I realized that it does make sense to have different choices in these two situations. I would like to keep my current choices
(51%)
It makes sense to have different choices
Which better represents your preference: your choice of [Option 1] over [Option 2], or your choice of [2] over [1]?
Why do you want to make different choices in these two situations?
Option 1 over 2 (43%)
Option 2 over 1 (47%)
I changed my mind: I realized that it does make sense to have different choices in these two situations. I would like to change *both* of my choices (10%)
Back
The two situations are different enough that I want different choices (57%)
Some of the options are equally good to me, so it doesn't matter which one I choose (25%)
I chose how I thought the experimenters wanted me to choose (3%)
I don't know which options I prefer (6%)
I don't know or am confused (4%)
Other _____ (5%)
Is this what you wanted your choices to be changed to?
Yes
Why did you want to change your choices as you did?
I made a mistake when I first chose (45%)
Answering all of these questions made me change what I want (36%)
Some of the options are equally good to me, so it doesn't matter which one I choose (12%)
I chose how I thought the experimenters wanted me to choose (1%)
I don't know which options I prefer (3%)
I don't know or am confused (1%)
Other _____ (2%)

Minimizing experimenter demand effects

- Participants may infer that they should, or experimenter wants them, to revise their earlier choice.
- To minimize:
  - We always offered options of keeping both choices the same and of switching both choices, making intent less obvious.
  - "Placebo inconsistencies": Asked participants to reconsider ¼ of choice pairs that were *consistent* with normative axiom.
    - Roughly as frequent as inconsistency reconsiderations.
    - Further masked intentions, and obtained placebo measure of how often participants update when prompted to do so.
      - Kept choices the same 98% of the time.
  - Directly offered participants option to select "I chose how I thought the experimenters wanted me to choose."
    - Selected *more* often when participants didn't revise an inconsistency (3%) than when they did (1%).

Reconsideration Phase

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  2. Intransitivities: all current pairwise-frame choices. (~1 total.)
     - Could be 3-way, 4-way, or 5-way (since 5 investment plans).

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     - Could be 3-way, 4-way, or 5-way (since 5 investment plans).
- Algorithm then repeated a 2nd time.

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Results: Reconsideration Procedure

- Reassuringly, virtually no updating in “placebo inconsistencies.”
- Yet substantial reductions in intransitivities and inconsistencies.

Number of Intransitivities Over the Experiment

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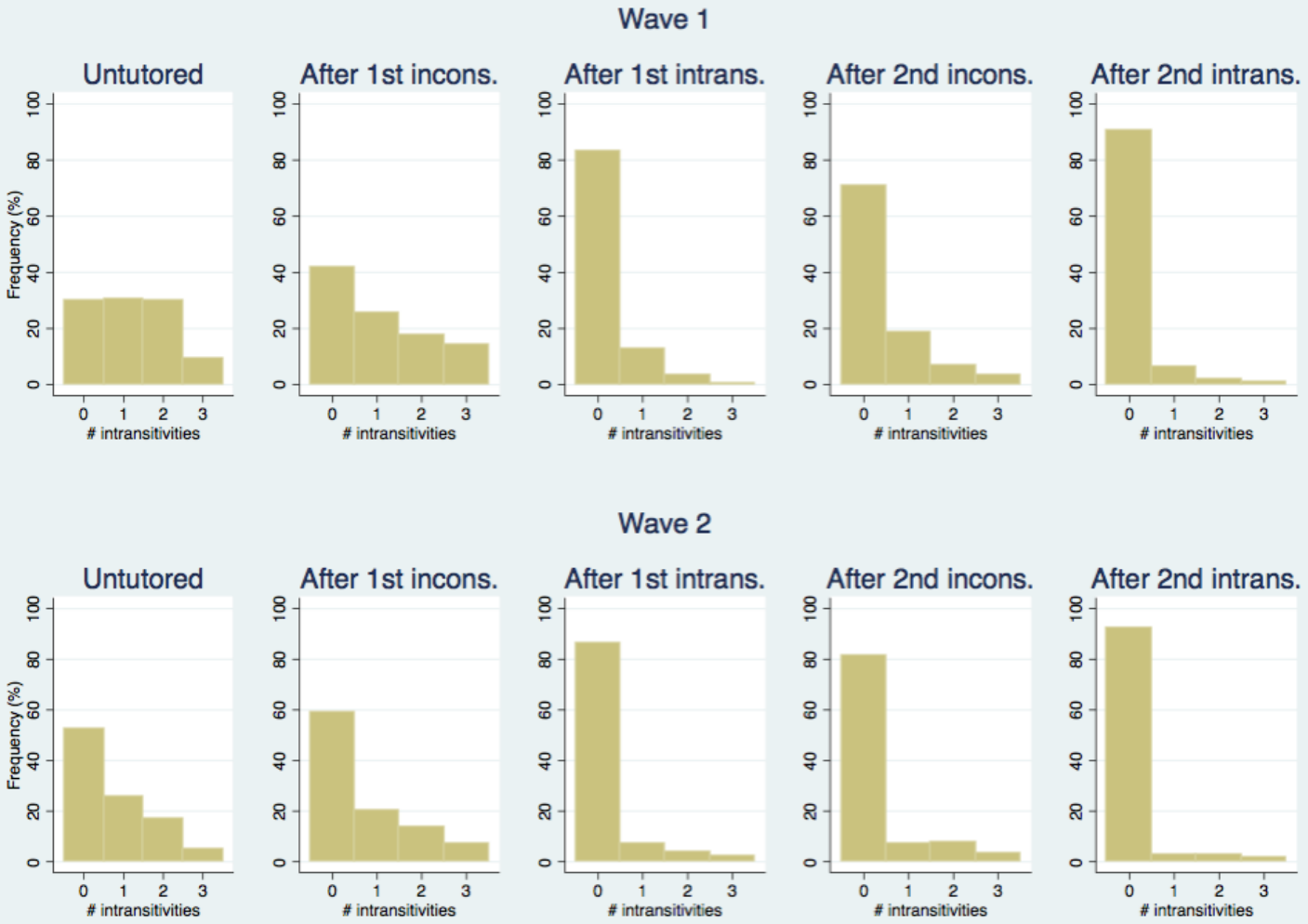

N = 214.

Number of Inconsistencies Over the Experiment

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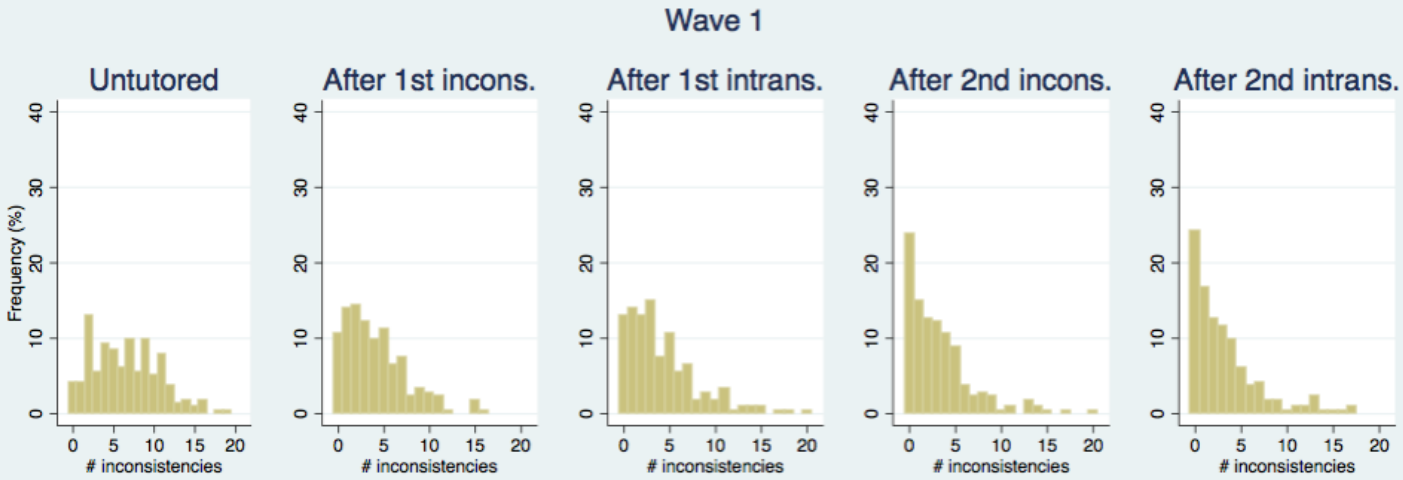

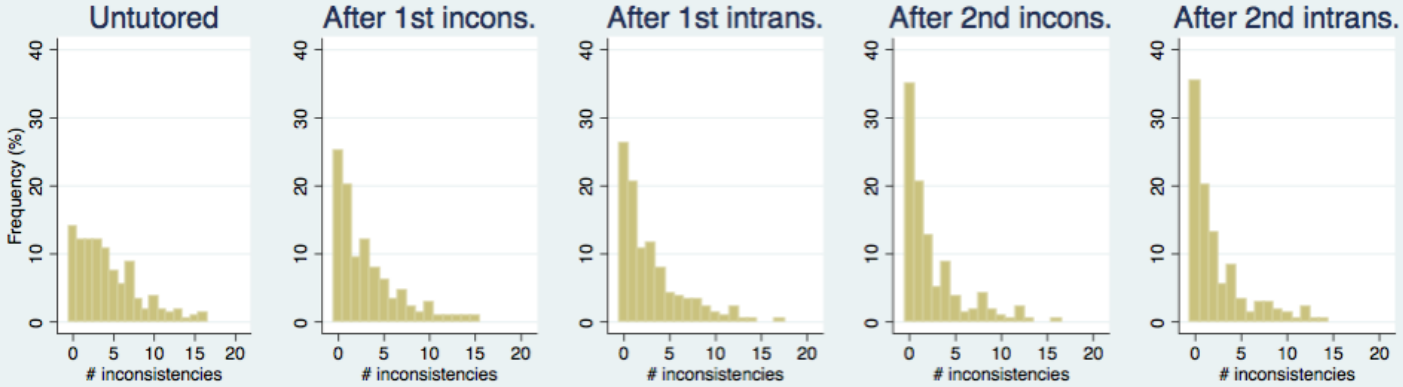

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Results: Reconsideration Procedure

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  - Implies that reconsideration is not in a random direction.
- When *didn't* revise inconsistencies, usually because the two frames were considered "different situations" (or because indifferent).
  - Consistent with rejecting the axiom.

Why Not Revise Inconsistent Choices (By Axiom)

Axiom	Different Situations	Indiff.	Expt'er Demand	IDK	Confused	Other	Total
Irrelevance of Background Counterfactuals	57%	21%	2%	9%	9%	2%	91
Simple Actions = State-Contingent Actions	74%	17%	2%	2%	4%	1%	116
Irrelevance of Counterfactual Choices	56%	25%	2%	9%	3%	5%	116
Fusion + Shift from Nodewise to Pairwise	63%	21%	2%	7%	4%	4%	244
Complete Strategies = Implied Lotteries	56%	25%	3%	7%	3%	6%	689
Reduction of Compound Lotteries	55%	28%	3%	5%	4%	6%	873
Overall	57%	25%	3%	6%	4%	5%	2129

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  - Consistent with rejecting the axiom.
- When revised inconsistencies, usually reported "made a mistake" or "change[d] what I want" (or indifferent).
  - Consistent with endorsing the axiom.

Why Revised Inconsistent Choices (By Axiom)

Axiom	Mistake	Learned	Indiff.	Expt'er Demand	IDK	Confused	Other	Total
Irrelevance of Background Counterfactuals	48%	34%	12%	1%	1%	1%	2%	91
Simple Actions = State-Contingent Actions	36%	38%	18%	0%	3%	2%	3%	61
Fusion + Shift from Nodewise to Pairwise	47%	32%	13%	1%	4%	2%	0%	166
Complete Strategies = Implied Lotteries	46%	35%	10%	1%	5%	1%	2%	678
Reduction of Compound Lotteries	45%	37%	12%	1%	2%	1%	2%	926
Overall	45%	36%	12%	1%	3%	1%	2%	1922

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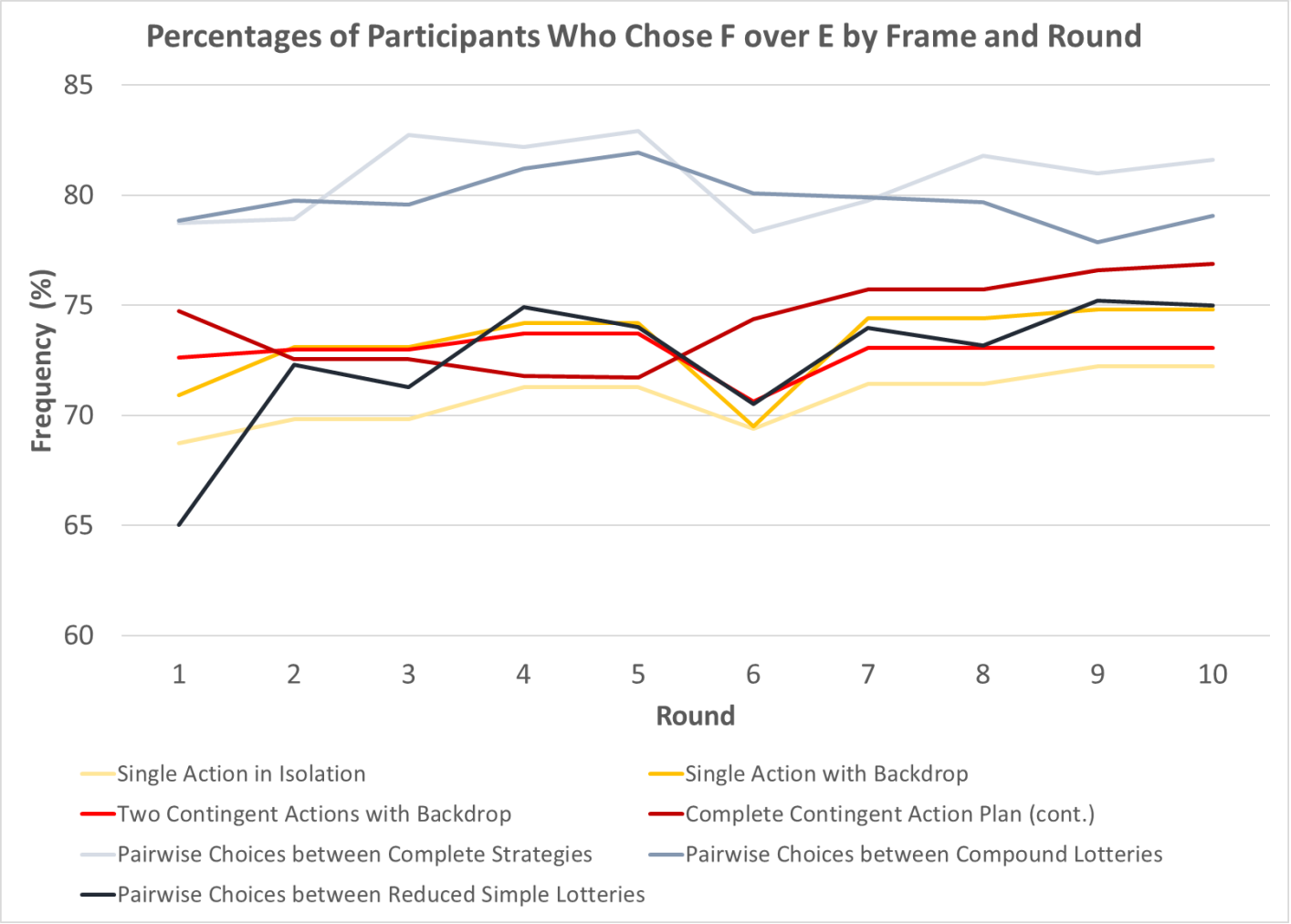
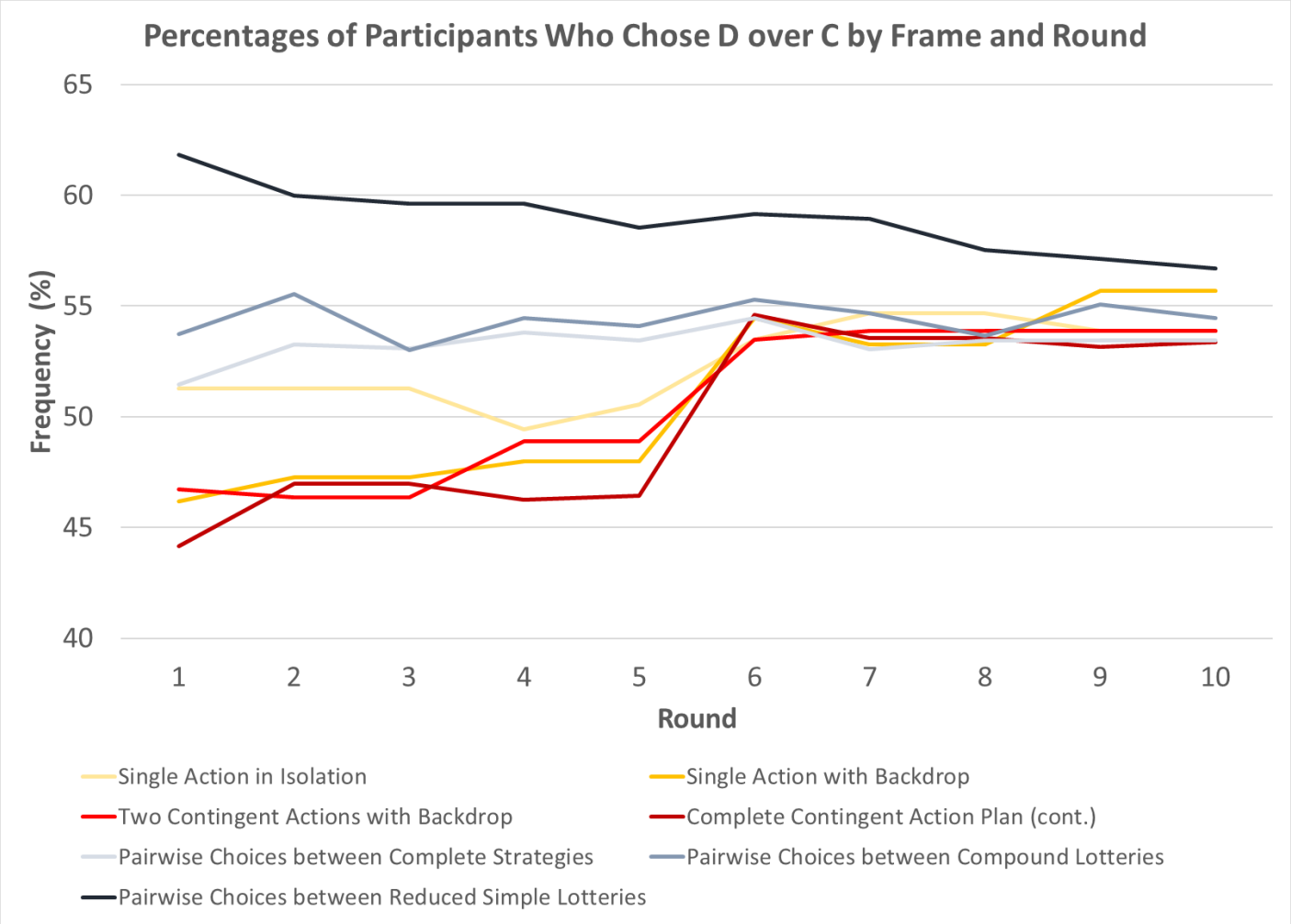
  - Consistent with rejecting the axiom.
- When revised inconsistencies, usually reported "made a mistake" or "change[d] what I want" (or indifferent).
  - Consistent with endorsing the axiom.
- Reconsidered choices on average were somewhat more risk tolerant.
- Participants often revised *away* from the choice they made in the frame "Pairwise Choices Between Reduced Simple Lotteries."
  - May be evidence against presumption that it elicits normative preferences.

% Choosing F (the risky option) over E



Note: For Pairwise frames, data from the 2 questions BCE vs. BCF and BDE vs. BDF are used.

% Choosing D (the risky option) over C



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Results: Reconsidered Choices

- By end of wave 2, almost no intransitivies remain.
  - Consistent with recent literature finding little evidence for intransitivity. (e.g., Regenwetter, Dana, and Davis-Stober, 2011; cf., Tversky, 1969)
- Most inconsistencies driven by relatively few participants.
  - 35% have 0, 55% have ≤1, and 68% have ≤2; only 14% have >5.
- With one exception, inconsistency rate is ≤11% for all axioms.
  - *Not* high inconsistency rate for Reduction of Compound Lotteries.
    - Consistent with axiom violations as reasoning/math errors.
- Exception is “Irrelevance of Counterfactual Choices” axioms.

Mean Inconsistency Rates

Axiom	U1	R1	U2	R2	*P*-value U1-R1	*P*-value U1-U2	*P*-value U2-R2	*N*
Irrelevance of Background Counterfactuals	13%	6%	8%	4%	<0.0005	0.0345	0.0008	236
Simple Actions = State-Contingent Actions	12%	9%	6%	6%	0.0218	0.0025	1	236
Irrelevance of Counterfactual Choices	14%	17%	12%	15%	0.0781	0.3713	0.1393	221
Fusion + Shift from Nodewise to Pairwise	25%	15%	18%	11%	<0.0005	0.0036	<0.0005	225
Complete Strategies = Implied Lotteries	22%	10%	14%	8%	<0.0005	<0.0005	<0.0005	232
Reduction of Compound Lotteries	26%	11%	18%	9%	<0.0005	<0.0005	<0.0005	231
Overall	23%	11%	15%	8%	<0.0005	<0.0005	<0.0005	214

Note: *P*-values are from two-sided t-test. Irrelevance of Counterfactual Choices adjusted by 2/3.

Mean Inconsistency Rates

Axiom	U1	R1	U2	R2	*P*-value U1-R1	*P*-value U1-U2	*P*-value U2-R2	*N*
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    - Consistent with axiom violations as reasoning/math errors.
- Exception is "Irrelevance of Counterfactual Choices" axioms.
  - Robustly remains an outlier when restrict attention to participants with ≤5 inconsistencies (who may be trying harder to resolve).

Mean Inconsistency Rates, ≤5 Inconsistencies

Axiom	U1	R1	U2	R2	*P*-value U1-R1	*P*-value U1-U2	*P*-value U2-R2	*N*
Irrelevance of Background Counterfactuals	11%	4%	6%	1%	<0.0005	0.0089	0.0001	184
Simple Actions = State-Contingent Actions	11%	7%	4%	4%	0.0513	0.0002	1.000	184
Irrelevance of Counterfactual Choices	21%	24%	14%	17%	0.2919	0.0120	0.3083	184
Fusion + Shift from Nodewise to Pairwise	23%	13%	14%	6%	<0.0005	<0.0005	<0.0005	184
Complete Strategies = Implied Lotteries	21%	8%	11%	4%	<0.0005	<0.0005	<0.0005	184
Reduction of Compound Lotteries	25%	8%	15%	4%	<0.0005	<0.0005	<0.0005	184
Overall	21%	9%	12%	5%	<0.0005	<0.0005	<0.0005	184

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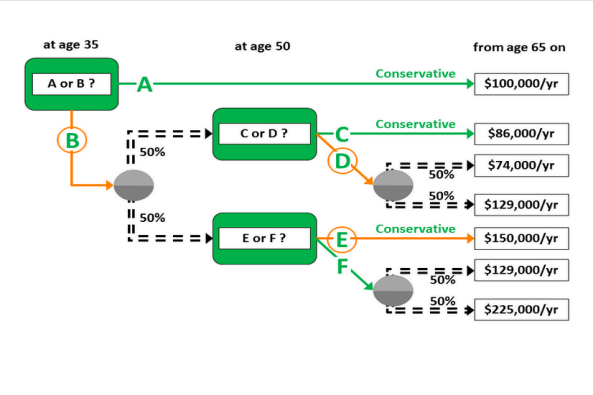
- Exception is "Irrelevance of Counterfactual Choices" axioms.
  - Robustly remains an outlier when restrict attention to participants with ≤5 inconsistencies (who may be trying harder to resolve).
  - Suggests that regret, or counterfactual reference point, drives some violations of EU—but the violations are *not* systematic.

Axiom: Irrelevance of Counterfactual Choices

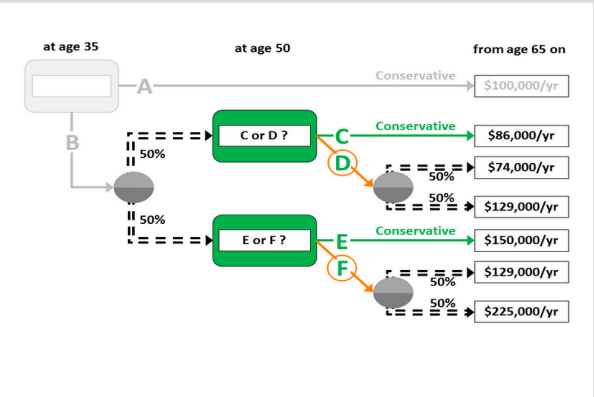
In one question you chose DE over DF, but in another question you chose DF over DE.

Do you think the two situations are different enough that it makes sense to have different choices, or should they be the same?

You chose DE:



You chose DF:



- It makes sense to have the same choice in both questions.
- It makes sense to have different choices.

Next >>

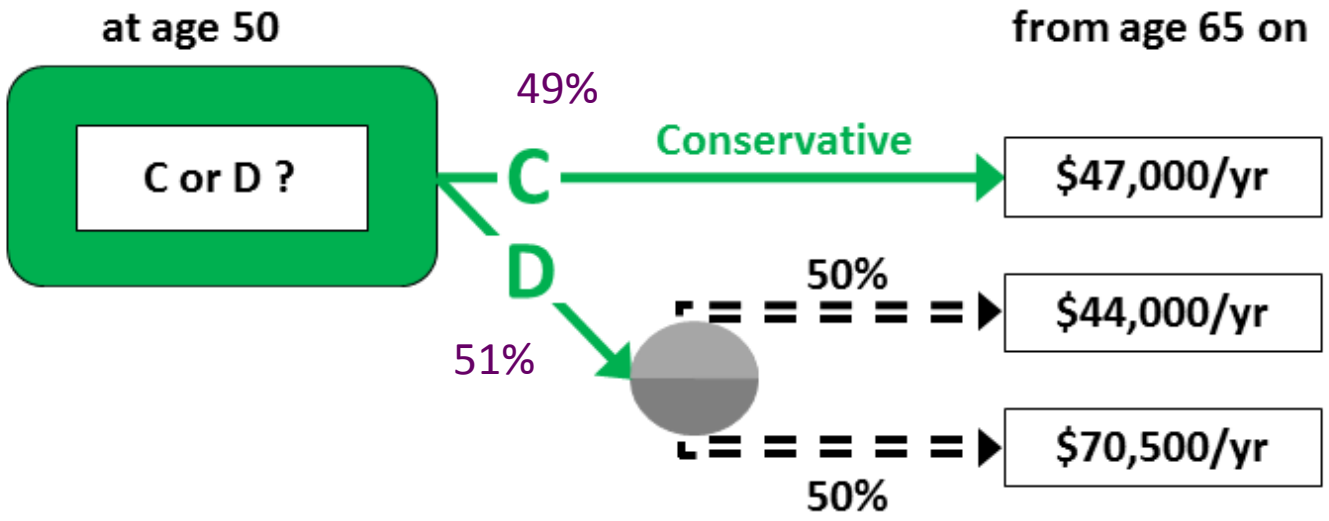
Outline

1. Introduction
2. Experiment Sample and Set-Up
3. Results
4. ***Conclusion***

Conclusion

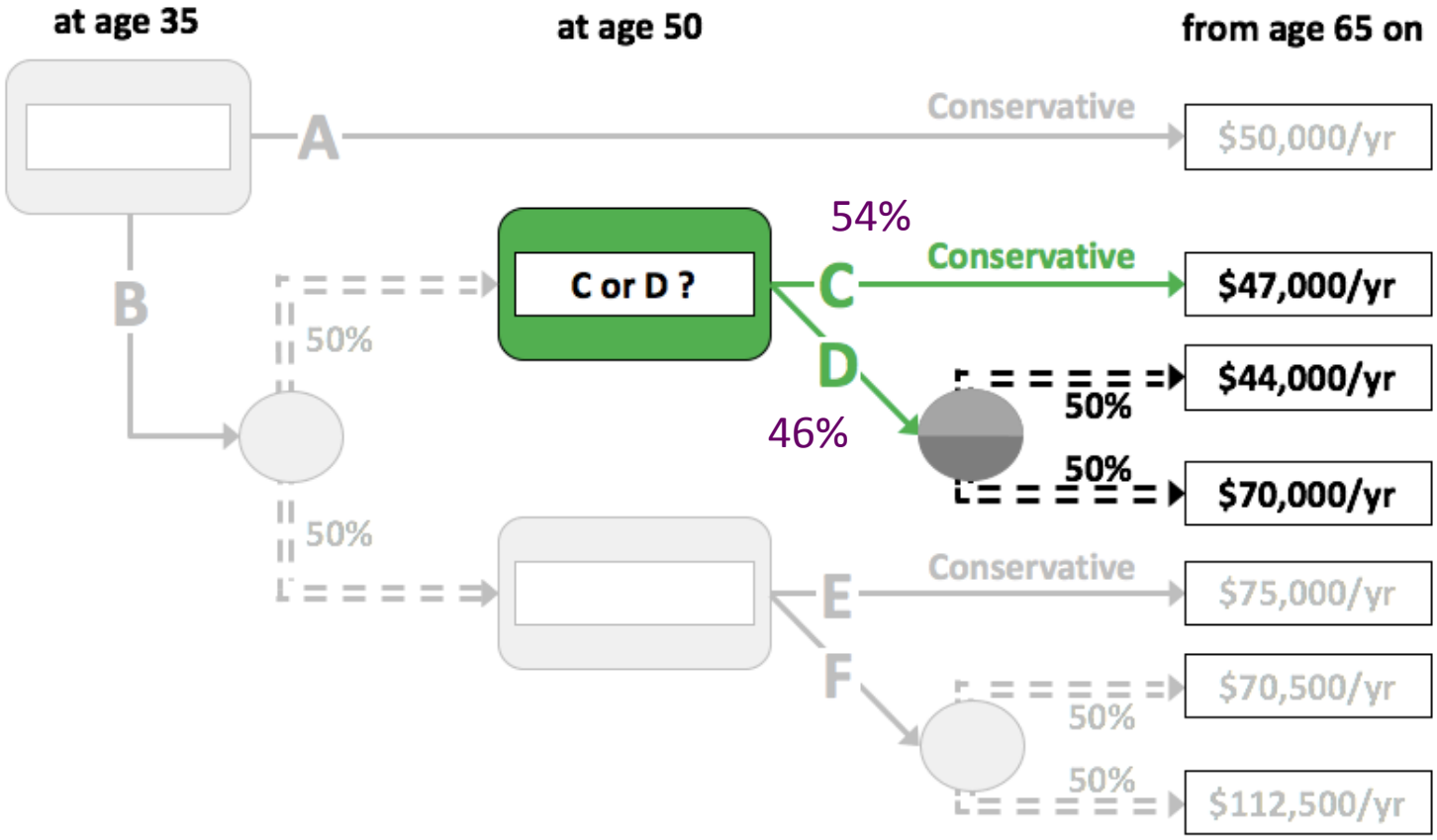
- Reconsideration virtually eliminates intransitivities and substantially reduces inconsistencies with EU axioms in our data.
  - Remaining inconsistencies concentrated among relatively few participants.
  - Primarily related to regret or counterfactual reference points.
- Results suggest other inconsistencies with EU are mainly mistakes, rather than normative preferences.
- Substantial convergence across frames of risk aversion estimated from reconsidered choices.
- Further work needed to test if reconsideration can lead to complete convergence in choices across frames.
- (Simplified!) version of method might be applicable for financial advice.
- Reconsideration method might be useful for helping to identify normative preferences in other types of choices.

Frame: Single Action in Isolation



Note: 2 such questions (C vs. D and E vs. F).

Frame: Single Action with Backdrop



Note: 2 such questions (C vs. D and E vs. F).