Could the Cold War have been avoided?

by

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Debates about President Truman's decision to drop nuclear bombs on Japan have in the eighty-one years since centered around the question of whether the lives of Americans spared were worth the human sacrifice on the ground. General Eisenhower was a contemporaneous opponent to dropping the bombs, believing that peace with Russia would have been possible had the bombs not been dropped. This paper formalizes Eisenhower's point with a signaling game in which the peaceful U.S. type can credibly reveal its intentions precisely because not dropping the bombs costs American lives, thereby avoiding the Cold War and the near-catastrophes it involved.

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Nobody wants to go through what we went through in Cuba very often.
John F. Kennedy, December 1962[1]

1 Introduction

At the Potsdam conference in the second half of July 1945, news about the successful test of a nuclear bomb in New Mexico was shared among the allied leadership. General Eisenhower instantaneously opposed the use of these devastating weapons against Japan that, in his view, "was already defeated." Overcome by depression, he was the lone dissenting voice at the conference, catching the ire of the Secretary of War, who "almost angrily refut[ed] the reasons I gave for my quick conclusions."[2] In August 1945 in Moscow, Eisenhower said that "[b]efore the bomb was used, I would have said yes, I was sure we could keep peace with Russia. Now I don't know. I had hoped the bomb wouldn't figure in this war ... People are frightened and disturbed all over. Everyone feels

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[1]The statement was made during a press conference; see e.g. Hastings (2022).

[2]See e.g. Smith (2013, p.449/50).

insecure again."[3]

Over the eighty plus years since, debates about President Truman's decision to drop nuclear bombs on Japan have almost exclusively centered around the question of whether the sparing of American soldiers' lives was worth the cost in terms of Japanese civilians killed and maimed.[4] The answer of Truman, who never "lost a night's sleep" over any decision he took in office, was affirmative.

In this paper, we set up and analyze a signaling game that formalizes Eisenhower's notion that, without dropping the bombs, peace with the Soviet Union would have been possible. In this game, the Soviet Union does not know whether the United States' type is peaceful or aggressive. Exactly because not dropping the nuclear bombs costs the lives of American soldiers can the peaceful type of the U.S. credibly reveal itself to the Soviet Union. Viewed from this perspective, the overall cost of dropping the bombs was not confined to the harm to the Japanese civilians on the ground in August 1945, but rather includes the increase in the likelihood of nuclear war that could easily have ended human civilization. Accordingly, the onset of the Cold War, which at various junctions nearly led to nuclear Armageddon, may as much have been caused by the lack of strategic thinking as by the advances in nuclear physics.

For sufficiently optimistic beliefs by the Soviet Union that the United States is peaceful the game exhibits only pooling equilibria in which the bombs are dropped and no nuclear arms race ensues. However, the pooling equilibria are at odds both with the observed history — bombs were dropped and a nuclear arms race followed — and the well-documented paranoia among the Soviet leadership at the time. It is, therefore, sensible to focus on the case that is consistent with the available evidence, which is the case of pessimistic beliefs.

Of course, a reading of the history of the Cold War easily lends itself to the conclusion that *mutually assured destruction*, aptly abbreviated *MAD*, worked. After all, we are here to contemplate this very question. But survivor bias is non-negligible. There is, by now, ample evidence that humanity escaped catastrophes, repeatedly, merely by a whisker. The Cuban missile crisis of 1962 is perhaps the best known episode. In the midst of it, President Kennedy assessed the odds of entering nuclear war at somewhere between one third and even.[5] The year 1983 alone gave rise to two incidents in which, to quote former U.S. Secretary of Defense Robert Gates, "[w]e may have been at the brink of nuclear war and not even known it."[6] In September 1983, Lieutenant-Colonel Stanislav Petrov's decision not to pass on the— false — alerts of an impending U.S. nuclear attack to the high command of the Red Army may have avoided nuclear holocaust. Ultimately, Petrov's decision — which later led U.N. Secretary General Kofi Annan to refer to him as "the man who saved the world" — was

[3]See Snow (1959, p.360/1).

[4]According to a letter cited in MacGregor (2025, p.333) dated from August 1963, Truman also mentions the Japanese lives saved because the war was shortened.

[5]Kennedy's assessment of the odds of nuclear Armageddon related to the Berlin crisis was one in five (Hastings, 2022, p.125).

[6]See Downing (2018, p.256).

based on the insight that an attack would consist of many more than the five or six missiles that the faulty alarm system showed.[7] This also shows that by the 1980s, strategic thinking had started to catch up with the advances in physics. However, the understanding of the strategic situation was still incomplete, as evidenced, for example, by the almost panic-stricken reaction of the paranoid Soviet leadership that could no longer listen in to the joint NATO manoeuvre *Able Archer* later that year because NATO had changed the codes. This led the Soviet leadership to prepare launching a nuclear attack on the West without the West even becoming aware of it (see e.g. Downing, 2018).[8]

Ongoing geopolitical tensions may renew interest in nuclear weapons and the existential threat that emanates from them. However, the fundamental problem is independent of political cycles and seems worthy of the attention of historians, political scientists and economists. By analyzing a simple signaling game in which restraint can help avoid an arms race, this paper provides a step toward a better understanding of the conditions under which disastrously dangerous situations can be avoided.

The contribution of this paper is not that costly actions can be used to credibly signal one's type but rather the observation that not dropping the bombs may have constituted such an action and that, accordingly, failure to recognize this may have induced the Cold War. To the best of our knowledge, these points have never been made before.

The remainder of this paper is organized as follows. Section 2 sets up the model. Section 3 shows that this game has a unique perfect Bayesian equilibrium (PBE) that satisfies the intuitive criterion of Cho and Kreps (1987), thereby conceptualizing Eisenhower's point. The discussion in Section 4 concludes the paper.

2 Setup

There are two players, called 1 and 2. Player 1 moves first. Player 1 has nuclear bombs while player 2 does not. Player 1's action set is $\{d, n\}$, where d stands for dropping the bombs and n for not dropping them but credibly revealing to player 2 that he has nuclear bombs and the destructive power these entail. The action set of player 2 is $\{R, N\}$, where R stands for starting an arms race by developing and producing nuclear weapons in large numbers and N stands for *not* starting an arms race, which includes the possibility of producing nuclear weapons in small numbers.

Types and beliefs Player 1's type is $\theta \in \{\theta_A, \theta_P\} \equiv \Theta$ with $\theta = \theta_A$ meaning that player 1 is aggressive and $\theta = \theta_P$ meaning that player 1 is peaceful. Player 2's prior that 1 is peaceful is denoted by π, which is assumed to satisfy $\pi \in (0, 1)$.

[7] See e.g. Downing (2018, p.194-201).

[8] Further evidence that the understanding of strategy was lagging behind that of physics is that Thomas Schelling's seminal book on the strategy of conflict (Schelling, 1960) was written a decade or two before the tools to study games with incomplete information were developed.

Given actions $a \in \{d, n\}$, $B \in \{N, R\}$ and type θ, player 1's and 2's payoffs are denoted $U(a, B, \theta)$ and $V(a, B, \theta)$, respectively. The extensive form of the game is displayed in Figure 1 for a specific parameterization of the payoffs, which are introduced below.

Denote by Δ_Θ the set of possible beliefs over the type space Θ, that is, $\Delta_\Theta = [0, 1]$. The sets of beliefs restricted to a strict subset of types, denoted Δ_{θ_A} and Δ_{θ_P}, are the singletons $\Delta_{\theta_A} = \{0\}$ and $\Delta_{\theta_P} = \{1\}$ since there are only two types in Θ. Let $\mu(a)$ denote 2's updated belief that player 1 is peaceful upon observing the action a.

A mixed strategy of player 1 is a mapping $\delta : \{\theta_A, \theta_P\} \to [0, 1]$ from his type θ to the probability that he plays d, where $\delta(\theta) \in [0, 1]$ is the probability that 1 plays d when of type θ (and $1 - \delta(\theta)$ is the probability of playing n). Player 2 moves after observing player 1's action $a \in \{d, n\}$. Accordingly, a mixed strategy for player 2 is a mapping $\rho : [0, 1] \to [0, 1]$ from his belief $\mu \in [0, 1]$ that player 1 is of type θ_P to the probability $\rho(\mu)$ that he plays R (and $1 - \rho(\mu)$ is the probability that he plays N).

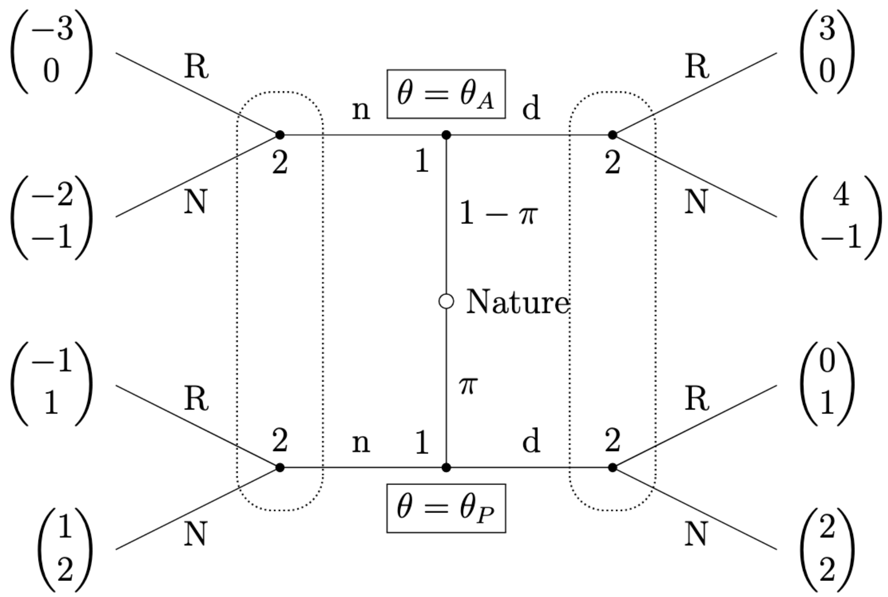

Figure 1
The signaling game for the parameterization in the text.

Payoffs We assume that *Truman*'s inequality holds, i.e., for any $B \in \{N, R\}$ and any $\theta \in \Theta$, we have

$$U(d, B, \theta) > U(n, B, \theta). \tag{T}$$

In words, whether or not player 1 is peaceful, keeping fixed the action of player 2, player 1's unique best action is dropping the bombs because that saves scores of young American lives.

We assume also what may be called *Eisenhower*'s inequality:

$$U(n, N, \theta_P) > U(d, R, \theta_P). \tag{E}$$

This is to say that the peaceful type of player 1 is better off by choosing n rather than d if 2 chooses N upon n and R upon d. By (T), we have $U(d, R, \theta_P) > U(n, R, \theta_P)$.

For the aggressive type, we assume that

$$U(d, R, \theta_A) > U(n, N, \theta_A) \tag{1}$$

holds. That is, the aggressive type prefers dropping the bombs and an arms race to not dropping the bombs and no arms race. Together with (T), this implies that for the aggressive type, d is a strictly dominant strategy.

We now turn to player 2. We assume that player 2 has a dominant strategy against either type of player 1. Specifically, for any $a \in \{d, n\}$, we have

$$V(a, R, \theta_A) > V(a, N, \theta_A) \quad \text{and} \quad V(a, N, \theta_P) > V(a, R, \theta_P).$$

That is, against the aggressive type, the unique optimal choice is R whereas facing the peaceful type the unique optimal action is N.

Let $\tilde{\pi} \in (0, 1)$ be such that

$$(1 - \tilde{\pi})[V(d, R, \theta_A) - V(d, N, \theta_A)] + \tilde{\pi}[V(d, R, \theta_P) - V(d, N, \theta_P)] = 0.$$

If 2's belief is $\tilde{\pi}$ and player 1 chooses d, then player 2 is indifferent between R and N while for any smaller (larger) belief player 2's unique best response to d is R (N). Given action $a \in \{d, n\}$ and belief $\mu \in [0, 1]$, denote by $BR(\mu, a)$ the best response correspondence of player 2 given action a and belief μ, and for a set of beliefs Δ, let $BR(\Delta, a) = \cup_{\mu \in \Delta} BR(\mu, a)$.

Parameterization used for illustration The following parameterization is used in Figure 1 and satisfies these conditions. For player 1, we have $U(n, N, \theta_P) = 1$, $U(n, R, \theta_P) = -1$, $U(d, R, \theta_P) = 0$ and $U(d, N, \theta_P) = 2$ for type θ_P, and $U(n, N, \theta_A) = -2$, $U(n, R, \theta_A) = -3$, $U(d, R, \theta_A) = 3$ and $U(d, N, \theta_A) = 4$ for type θ_A, while for player 2, we set $V(d, N, \theta_P) = V(n, N, \theta_P) = 2$ and $V(d, R, \theta_P) = V(n, R, \theta_P) = 1$, and $V(d, N, \theta_A) = V(n, N, \theta_A) = -1$ and $V(d, R, \theta_A) = V(n, R, \theta_A) = 0$. It implies $\tilde{\pi} = 1/2$.

This parameterization has the perhaps not unrealistic feature that player 2 does not care about player 1's action, only about his type. At the same time, if player 1 were commonly known to be peaceful, the best response of 2 would be N. Hence, if it were common knowledge that 1 is the peaceful type, his unique optimal action would be d.

Intuitive criterion Our focus is on perfect Bayesian equilibria (PBE) (Mas-Colell, Whinston, and Green, 1995). Because there can be multiple PBE that differ in the actions taken on the equilibrium path of play, we refine these equilibria by restricting attention to PBE that satisfy the *intuitive criterion* introduced by Cho and Kreps (1987). The intuitive criterion stipulates that, upon observing an off-path action—which is an action that according to the equilibrium strategy profile has prior probability of 0, implying that Bayes' rule cannot be used to update beliefs—provided there are types who could have benefited from the deviation, player 2 should assign 0 probability to any type who could not possibly have benefited from that deviation because its equilibrium payoff is larger than the largest payoff it can get from the deviation. That is, the deviation is equilibrium-payoff dominated for this type.[9] If a deviation is equilibrium-payoff dominated for all types, the intuitive criterion does not restrict beliefs.

Given that there are only two types of and two actions for player 1, the formal definition of the intuitive criterion for our game is relatively simple. Following broadly Banks, Camerer, and Porter (1994), we let $u^*(\theta)$ denote the expected payoff of player 1 when of type θ in a PBE of interest. For an off-path action a (of which there can be at most one given the binary action set), denote by $\Theta(a) = \{\theta \in \Theta : u^*(\theta) > \max_{\rho \in BR(\Delta_\Theta, a)} u(a, \rho, \theta)\}$ the possibly empty set of types for which the deviation a is equilibrium-payoff dominated, where $u(a, \rho, \theta) = \rho U(a, R, \theta) + (1-\rho)U(a, N, \theta)$ is the extension of the utility function U to its expectation, and let $\Delta(a) = \Delta_{\Theta \setminus \Theta(a)}$. Given the binary types, if $\Theta(a)$ is non-empty, then $\Delta(a)$ is a singleton. A PBE strategy profile $\langle \delta^*, \rho^* \rangle$ with beliefs $\mu(.)$ satisfies the *intuitive criterion* if for any off-path action a, $\mu(a) \in \Delta(a)$. The intuitive criterion is in many ways the weakest of the commonly used refinements (see Banks, Camerer, and Porter, 1994), and it seems difficult to refute it because the underlying logic is compelling, with, for example, Riley (2001, p.445) writing: "I find the intuitive criterion persuasive".

To illustrate, consider the case of two species, say, frogs, who are player 1. Their color adaption has evolved under the threat of attack by a predator (player 2). Neither frog species likes being attacked. One of two types of frogs, denoted θ_P, is *strong* in the sense that the predator does not want to attack it. The other species, whose type is denoted θ_A, is weak in the sense that the predator wants to attack it. The species differ also in their preferred color. The weak species likes green and the strong species likes red, but each species is willing to evolve into their less preferred color if that avoids being attacked. The predator observes the color of the frog it encounters, without caring about its color per se,

[9] Mas-Colell, Whinston, and Green (1995, p.486) define beliefs as "reasonable" if these beliefs assign zero probability to types for whom an observed off-path action is dominated. Because a dominated action is equilibrium-payoff dominated and because n is dominated by d for the aggressive type, confining attention to such reasonable beliefs will yield the same outcome as the intuitive criterion.

and it knows the population frequency π of the strong species. Under suitable parameter restrictions, in particular π large enough, this game has two pooling PBE. Qua pooling, in each of them, both species choose the same color —green or red — and the predator does not attack on the equilibrium path but attacks with sufficiently high probability after observing the off-path color, that is, the color it should not observe according to the equilibrium under consideration. The question then is which of these pooling PBE is more plausible — the one with green on the equilibrium path where the strong mimics the weak or the one with red on the equilibrium path where the weak mimics the strong. According to the intuitive criterion, the plausible PBE is the one where the weak mimics the strong. This — mimicry of the strong by the weak — is what evolutionary biologists observe. The reason is simply that, deviating from the equilibrium strategy according to which both choose green, the strong, who is now red, essentially tells the predator to better think twice before attacking it for, after all, the weak species gets its first best on path, whereas the strong type does not, and the predator does not want to attack the strong species.[10]

3 Eisenhower's, and possibly Oppenheimer's, point

We now proceed to the equilibrium analysis. As the following proposition shows, the PBE satisfying the intuitive criterion is different when player 2 has sufficiently optimistic prior beliefs about player 1 being peaceful, that is, for $\pi \geq \tilde{\pi}$, and when player 2 does not hold such sanguine beliefs. In the former case, no arms race occurs on the equilibrium path of play whereas in the latter it happens if and only if player 1 is the aggressive type.

PROPOSITION 1 *In any PBE, $\delta^*(\theta_A) = 1$. For $\pi > \tilde{\pi}$, the unique PBE satisfying the intuitive criterion has player 1 pool at d and player 2 choosing N on path, that is, it is such that $\delta^*(\theta) = 1$ for both $\theta \in \{\theta_A, \theta_P\}$ and $\mu(d) = \pi$ and $\rho^*(\mu(d)) = 0$. For $\pi < \tilde{\pi}$, the unique PBE satisfying the intuitive criterion is separating $\delta^*(\theta_P) = 0$ and player 2 choosing N upon observing n and R upon observing d, i.e. $\rho^*(\mu(n)) = 0$ and $\rho^*(\mu(d)) = 1$, with beliefs $\mu(n) = 1$ and $\mu(d) = 0$.*

PROOF That $\delta^*(\theta_A) = 1$ in any PBE follows from the facts that d is strictly dominant for the aggressive type and that strictly dominated actions cannot be played in any equilibrium. The only question then is what action type θ_P takes. For $\pi \geq \tilde{\pi}$, the pooling equilibrium, which requires $\delta^*(\theta_P) = 1$, is such that $\mu(d) = \pi$, which makes it optimal for 2 to play N on path. Both types of player 1 thus get their maximum achievable payoffs in this equilibrium, and hence any deviation is equilibrium payoff dominated for both. Thus, this pooling PBE sat-

[10] In our notation, d would mean "green," n "red," N "do not attack" and R "attack". With $V(a, R, \theta_A) - V(a, N, \theta_A) = 1$, $V(a, R, \theta_P) - V(a, N, \theta_P) = -1$, $U(d, B, \theta_A) - U(n, B, \theta_A) = 1$, $U(d, B, \theta_P) - U(n, B, \theta_P) = -1$ and $U(a, N, \theta) - U(a, R, \theta) = 2$ for all $a \in \{d, n\}, \theta \in \Theta$ and $B \in \{R, N\}$ and $\pi = 0.9$, this is the beer-quiche game of Cho and Kreps (1987).

isfies the intuitive criterion. For $\pi < \tilde{\pi}$, the separating PBE with $\delta^*(\theta_P) = 0$ trivially satisfies the intuitive criterion because no action is off path. In contrast, the pooling PBE with $\delta^*(\theta) = 1$ for both $\theta \in \Theta$ and $\rho^*(\mu(d)) = 1$ does not satisfy the intuitive criterion because the deviation to n is (equilibrium payoff) dominated for type θ_A but not for θ_P. Hence, upon observing the off-path action n, 2 must believe that 1 is the peaceful type, i.e. $\mu(n) = 1$, in which case its uniquely optimal action is $\rho = 0$, making the deviation profitable for type θ_P.

The pooling PBE — in which the bombs are dropped, followed by no arms race— exist for sufficiently optimistic beliefs by player 2 about player 1's type being peaceful, that is, for $\pi \geq \tilde{\pi}$. However, the idea that the Soviet leadership held such optimistic beliefs is at odds with the well-documented fear bordering paranoia in the Soviet Union before and after the bombs were dropped (see, for example, the Eisenhower quote in the introductory paragraph and chapter 26 in Snow (1959, Part Three), which is called "Hiroshima in Moscow"). We therefore focus on the case $\pi < \tilde{\pi}$. This is also the case that is consistent with the observed history insofar as bombs were dropped and a nuclear arms race ensued.

Perhaps ironically, it is precisely Truman's inequality (T) around which most of the debates since have centered that permits the peaceful type to credibly signal his type. Put differently, this conceptualization of the argument that Eisenhower made is not denying that Truman's calculations were wrong, merely that they did not account for the larger strategic implications. As it is Truman's inequality that would have permitted Truman to credibly signal his peaceful intentions, the argument explicitly acknowledges the cost in terms of American soldiers' lives this would have entailed.

If $\pi \leq \tilde{\pi}$, there is a pooling PBE in which $\delta^*(\theta_P) = 1$ as well and $\mu(d) = \pi$. However, this equilibrium rests on the threat of player 2 to play R with sufficiently high probability upon observing the off-equilibrium action n, which in turn requires 2 to assign sufficiently high probability on this deviation coming from the aggressive type, i.e., μ to be sufficiently small. But the action n being equilibrium-payoff dominated for the aggressive type, the intuitive criterion requires 2 to assign zero probability to this deviation stemming from the aggressive type. Hence, $\mu(n) = 1$. But this implies that the unique optimal action for 2 upon observing n is N, which in turn implies that the deviation from d to n pays off for the peaceful type. Hence, these pooling equilibria do not satisfy the intuitive criterion.

In contrast, the separating PBE — in which $\delta^*(\theta_A) = 1$ and $\delta^*(\theta_A) = 0$ — trivially satisfies the intuitive criterion because there are no off-the-equilibrium-path observations, implying that $\mu(n) = 1$ and $\mu(d) = 0$ are pinned down by the equilibrium strategy profile alone.

4 Discussion

This paper provides a formalization of the possibility for peace with Russia through restraint Eisenhower believed to be possible. Within our model, Truman's decision to drop the bombs to save American soldiers' lives was based on a focus on inequality (T) and a disregard of the benefits of restraint that avoids an arms race, i.e., inequality (E). This disregard is in turn consistent with Truman's conviction that Russia would never be able to develop nuclear weapons. As Bird and Sherwin (2005, p.331) write, in a meeting with Oppenheimer in the Oval Office in October 1945, "Truman asked him to guess when the Russians would develop their own atomic weapons. When Oppie replied that he did not know, Truman confidently replied that he knew the answer: 'Never.' "

Assuming the model analyzed here correctly captures the players' payoffs and the structure of the strategic situation, the question arises why the bombs were dropped in August 1945. The only equilibrium outcome that is consistent with the observed history is the separating equilibrium satisfying the intuitive criterion when the U.S. is the aggressive type.[11] Assuming, as evidence suggests, that Truman was peaceful, this implies that dropping the bombs was a strategic error rather than an equilibrium outcome. Given the fundamental novelty of the strategic challenges posed by nuclear weapons, Truman's lack of foreign policy experience and knowledge of the Manhattan project before becoming commander in chief in April 1945, the interpretation of a strategic error seems plausible.[12] Moreover, as noted, if it were commonly known that player 1 is the peaceful type, player 2 would best respond by not starting the arms race, and 1's action choice would thus have no impact on the subsequent play, making dropping the bombs the uniquely optimal action. The parameterization used in the figure is such that player 2 is completely indifferent about 1's action and only cares about its type. So a plausible interpretation of the history in light of the model would be that Stalin was uncertain about Truman's type while Truman had no doubts about himself being peaceful, but neglected the fact that Stalin did not share that knowledge and the possibility of inducing an arms race.

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[11] In the pooling equilibria that exist for optimistic beliefs, there is no arms race on the equilibrium path.

[12] It is also consistent with experimental evidence suggesting that learning in games, including learning to play equilibria consistent with the intuitive criterion, takes time and experience (see e.g. Brandts and Holt, 1992, 1993; Banks, Camerer, and Porter, 1994), which real-world decision-makers are not necessarily granted.

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