

## *Game Theory Meets the Bible*

*Game Theory and the Humanities: Bridging Two Worlds, Biblical Games: Game Theory and the Hebrew Bible, and Superior Beings: If They Exist, How Would We Know?*  
by Steven J. Brams

A review by Karl-Dieter Crisman, Associate Professor of Mathematics, Gordon College

The purpose of this review<sup>1</sup> is to make the readers of this journal aware of a very interesting set of applications of mathematics that bring it into the realm of the humanities – and, in particular, of Biblical studies and theology. As one can see from the titles of the books under review, the author has invested considerable time in attempting to connect these areas using the tools of game theory.

Contrary to the usual practice in such a review, I will encourage the reader to persevere by giving away my final analysis. Brams, Professor of Politics at New York University and a highly respected researcher in many areas of choice and voting, mostly achieves his goals in these books. While it is unclear to me whether any of them, except perhaps *Biblical Games*<sup>2</sup>, would be appropriate as a main text for a course, all three of them are good sources for intriguing examples. They belong in the library of any Christian college, and are worth investigation by any Christian mathematician.

So what is, exactly, the connection between game theory and (say) theology? In order to get there, it is worth examining (2x2 noncooperative ordinal) game theory in a specific context other than the usual economic or geopolitical setting. We'll look at this example in some detail, but the reader is welcome to skip ahead to the wealth of topics touched on in these books.

One of Brams' best examples is of the famous Watergate episode. Just what was Nixon thinking in potentially defying the Supreme Court to turn over the missing tapes? In this context, Nixon appointees Warren Burger and Harry Blackmun are assumed to be the only possible dissenters from a unanimous decision for Nixon to comply. One can think of this as a simple bimatrix game, with Nixon and the two justices as the players.

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<sup>1</sup> Some material in this review appeared in (Crisman, Karl-Dieter (2014) "Game Theory Meets the Humanities and Both Win OR Book Review: Game Theory and the Humanities: Bridging Two Worlds, by Steven J. Brams," *Journal of Humanistic Mathematics*: Vol. 4: Iss. 1, pages 166-170.) I thank the editors of that journal for seeing the value in having two complementary reviews of these books from different starting points.

<sup>2</sup> Indeed, this book had its source in an undergraduate seminar Brams led at NYU seeing how game theory and the Bible might interact; however, the target audience of such a text would have to be unafraid (though not sophisticated) mathematically as well as willing to explore Biblical stories from some unusual angles.

	Burger and Blackmun decide for Nixon	Burger and Blackmun decide against Nixon
Nixon complies with the Court	(N 3, BB 4)	(N 1, BB 2)
Nixon defies the Court	(N 4, BB 1)	(N 2, BB 3)

This game matrix represents Brams' analysis of likely preferences of the actors, where 4 is the best and 1 is the least preferred. The president's overriding goal is to avoid a unanimous court; however, as a secondary goal he'd like to be able to not turn over the tapes, knowing that in either case he will lose the case. The justices, on the other hand, most want to avoid a constitutional crisis where Nixon defies the Court because it is not unanimous, and would most prefer to rule with him but see him still obey rule of law from the majority decision.

Those who know a little game theory will know that (2, 3) is the lone Nash equilibrium, where neither party benefits from changing their mind, and this is indeed what happened. Without the potential for each "player" to threaten to move to a different outcome, it is hard to see how the outcome could have been otherwise between rational players (even if Nixon could have avoided the confrontation before the game started with some foresight).

So far, so good. But Brams' real contribution to this kind of study (and the basis for much of the first and third books under review) is his *Theory of Moves (TOM)*; this is the idea that in some games, one really can view the players as being able to threaten to move from a Nash equilibrium (or other state) in order to try to force a better outcome over many rounds of play<sup>3 4</sup>. Now, each player can only move within a row or a column, depending on which player s/he is. Nonetheless, often this threat to move to a worse outcome (perhaps for both) leads to a move by the other player of a similar type, and so forth.

The real consequence of TOM is that one can extrapolate from all starting positions what moves might be made or threatened. Then *both* players can see what outcomes are possible ending states and choose a *Nonmyopic Equilibrium* state. In the Nixon-Court game, this is the Pareto-optimal (3,4), which is clearly better for *both* players than the actual outcome. To fully understand why this analysis works, I recommend a careful reading of pages 61-63 of *Game Theory and the Humanities* (where this is introduced)<sup>5</sup>; the essence is that by predicting threats and moves, each player will know where to stop threatening and moving for a preferred outcome. In general games, these equilibria are not uniformly Pareto-optimal<sup>6</sup>, but to my view,

<sup>3</sup> For instance, in Author-Reader, if A moves from (2,3) to the (worse) (1,1), R will definitely want to move to (3,4).

<sup>4</sup> In fact, many of the analyses take into account that one party must move first, such as the Court in this case, yielding a 2 by 4 payoff matrix

<sup>5</sup> The short version is that Author knows Reader would prefer to stay at the Nash equilibrium than switch to (4,1); so Author will choose not to exercise the move from (3,4) to (4,1), but *Reader* prefers (3,4) to (1,2), and will also then choose not to move from (3,4).

<sup>6</sup> Though in the 2x2 case there is only one half-exception.

any theory that can give a good way to get from a non-optimal Nash equilibrium to a Pareto-optimal outcome is very much worth exploring!

*Game Theory and the Humanities* touches on a slew of other topics from this vantage point. Like the other two books, it is largely comprised of substantial rewrites of both well-known and more obscure pieces by the author, but this does not diminish the impressive array of disciplines covered. Some topics in the humanities one might expect lend themselves well to game-theoretic analysis. Some samples:

- Joseph Heller's original *Catch-22*
- A reconstruction of the possible games played in the Iran hostage crisis
- Magnanimity after wars, such as the Franco-Prussian War (these both are counted as "history", not "political science")
- *Macbeth*

Many of these<sup>7</sup> (at least to me) make good sense, and help cut through the knot of entangled possible motives for postbellum dealings. Much the same can be said of the other chapters – using basic game theory, one can start to explain behavior as *rational* (for instance, within the setup of a novel) that otherwise might be hard to understand. This is a key concept in the book; the goal is not to provide definitive conclusions about (say) *Macbeth*; indeed, it is possible that experts in *Macbeth* would find the analysis too complex or too simplistic<sup>8</sup>. The point is to move toward recognition that difficult episodes (whether real or fictional) might be less enigmatic than the common wisdom would suggest, and that game theory can help elucidate them.

Now, I would argue that no set of episodes in other literature is more enigmatic and yet compelling than those in the Hebrew Bible. The dealings between God and humanity often seem, even to the most devout reader, arbitrary and confusing; to many skeptics, this is cause enough to reject any meaning beyond fairly basic storytelling. Could this same approach help us understand these sacred texts?

Brams would argue yes, and does so at length in the two remaining books<sup>9</sup>. At the same time, one might take pause before using a tool with the name "game theory" where participants are "players"! The author steers a good middle course here: "Since God does not always get His way, He can properly be viewed as a participant, or *player*, in a game... God Himself often provides explicit reasons for acting in a particular way, [so] it is hard to maintain that His motivations and design are unfathomable." If God (or a more generic superior being) can have purposes and motives that He might want us to be aware of, and if humans nearly always have (possibly poor) motives and purposes, it seems reasonable and not at all blasphemous to this reviewer to think about how to understand the relationship between God and ourselves with any tools we have at our disposal, as long as we maintain proper respect.

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<sup>7</sup> There are no fewer than 34 literary works and operas listed on page 6 to which game theory has at some point been applied – doubtless an incomplete list.

<sup>8</sup> And as Brams says in *Superior Beings*, such readers are invited to derive their own conclusions from different starting points, but with the same methods!

<sup>9</sup> For the reader who can only pick one of these books, one should know that Brams devotes two chapters of *Game Theory and the Humanities* to summarizing extended arguments and examples from the other two books.

Or at least it seems no more blasphemous than Moses' pleading with God to spare Israel after the golden calf incident and Abraham pleading to save Sodom, or Jephthah's foolish oath, or... and Brams analyzes many of the most difficult stories of the Hebrew Bible in *Biblical Games*. The book is roughly chronological in order, and (unsurprisingly) the first game described is one between God and Adam and Eve. Major space is given to Abraham and Isaac, the various Genesis brother conflicts, Moses' long-term struggle with Pharaoh (aptly described as a multi-round game), and Saul versus David, among *many* others.

I doubt any reader will agree with the analysis of all of them. But it is hard to disagree with Brams' conclusion that "In story after story, positing biblical characters as players in games provides a natural interpretation of the events described". If we recall that game theory is most of all about *strategy in conflict*; certainly all of the human characters are constantly strategizing. Think of David pointing out that you do not touch the Lord's anointed – well, it's not just Saul who is the Lord's anointed!<sup>10</sup> Curiously, Brams passes over this statement in puzzlement, noting only that David's prediction that Saul will die in another manner comes true.

Again, in the story of the sacrifice of Isaac, or *Akedah* (which motivated Kierkegaard's famous reflection *Fear and Trembling*), there is really something to think about – including several different possible sets of preferred outcomes for Abraham. Few choices could be more fraught with consequence, and yet the author suggests that "God's test does not assuredly dispel doubts about Abraham's faith, given Abraham knows God's preferences and is rational." Brams adds additional analysis related to the theory of moves in a new chapter for the second edition, which reaches some surprising (and to me, less convincing) conclusions about how Abraham could have behaved in order to knowingly save Isaac.

For those unsure about whether God could be treated as having motivation in this way, I encourage one to read the full treatment, which I think will convince one of the appropriateness and utility of examining such stories through this lens<sup>11</sup>, even if one might not accept all the conclusions. After all, Brams says such people should seek "alternative – if not superior – strategic representations of the situations". Of course, not all such attempts will be felicitous; there is a paper (not by Brams) examining Jesus' crucifixion and Judas' motivation (among other things) from this perspective which I fear does not really "clarify aspects of the Gospel narrative that have puzzled readers for the past 2000 years", but instead unknowingly discovers ground Biblical scholars have trod before. But the attempt should be made nonetheless.

The flavor of these games, as well as the discussion in the book, is rather different than in the humanities text. First of all, this is an older book, from about the same time as Brams and his collaborators were first developing the "Theory of Moves", so the analysis is fairly straightforward from a game theory perspective. Secondly, there is very extended exposition of the Biblical text in each chapter and section. This is useful to those unfamiliar with the stories – such as most students and mathematicians! But being interspersed with (Brams' own ideas about) potential motivations of God or other persons, it does take a while to get to the game

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<sup>10</sup> I am indebted to my colleague Paul Borgman for this insight, which shows that David can be God-fearing *and* politically canny at the same time

<sup>11</sup> Indeed, one of my students, Joel Nolette, based a good paper on coming up with his own (quite orthodox) game matrix for the Akedah. I can see a lot of promise for student projects or even publications coming from the ideas in this book.

matrices, and to the very Biblically literate<sup>12</sup> this could be slightly tiresome. I find the combination to work well, but it does mean that it's best to read each chapter on its own terms, viewing the book as a collection of closely related essays.

In the second edition of *Biblical Games*, there is a final chapter (also represented in *Game Theory in the Humanities*) which introduces the far more philosophical approach which is the entire point of *Superior Beings*. Namely, if a superior being (not necessarily a theistic one) existed, how might it behave with respect to revelation and in view of traits like omnipotence? Again here it is important to emphasize that although never credulous, Brams respects the subject matter and discourse: "The clues [the Bible] offers on God's preferences and powers do not seem to me contradicted by contemporary events;" "[Most western religions rest] on the notion that God can be conceived of in personal terms ... a personal God in a one-to-one relationship with each of us."

Unfortunately, *Superior Beings* is a denser book than the others. Even the review of the second edition in the Notices of the AMS – not a publication known to shy away from dense reasoning – points this out. That said, it is the reasoning which is dense, not the difficulty level which is high; the Theory of Moves comes in a little later in the book, and much of it is devoted to discussing different approaches to various problems. I could imagine this being used as a set of readings for discussion between a theology and mathematics department, for example.

So what kind of questions might we ask about strategy between a superior being (a SB, whatever that might be) and us? Brams returns again and again to the question of knowability, and the essential conflict between a superior being desiring (in whatever sense that means) both for humans to believe in Him<sup>13</sup> and to remain somehow unknowable or inscrutable. Naturally, Pascal's wager is one of the early examples; the payoff matrix described includes a *third* option in addition to (verifiability of) God's existence or non-existence – a state of uncertainty. This is a typical approach for the book; we may not ever be able to decide whether SB exists.

Here is the very first example. In this case, the SB wants to remain unknowable if possible, and the person wants to be right.

	Investigate knowability	Don't investigate knowability
SB knowable	(1,4)	(2,2)
SB unknowable	(3,1)	(4,3)

It's pretty clear that an unknown SB and a human who doesn't bother to find out will be the result here. If you think that's not the God of the (Hebrew) Bible, Brams seems to agree, and posits four other variants on the game, some of which have very different outcomes. I particularly recommend the (long) discussion on a paradox of omniscience, and several *possible* resolutions. The entire argument is somewhat technical, but the paradox itself is that in Chicken-like games<sup>14</sup>,

<sup>12</sup> Or those who significantly disagree with the interpretations.

<sup>13</sup> Brams and I both find it easier to use this pronoun than the current alternatives, even though said superior being might be anything from the devil to a genderless alien.

<sup>14</sup> This is a technical term, but I think most readers will understand the allusion.

if the non-SB *knows* that the SB is omniscient, s/he can plan not to swerve, in which case the SB must swerve, based on that knowledge! I do not know if theologians have discussed similar paradoxes, but it certainly seems fruitful to do so.

There are many other topics – always carefully but agnostically argued – such as Newcomb's problem, problems from one player's immortality in repeated games, and a very unusual take on the so-called "problem of evil". This last one supposes a not-quite-omniscient (perhaps allowing for free will, for instance) SB with a probability  $p$  of accurately detecting the non-SB's strategy. For some games, one can calculate that SB should then follow a "mixed strategy"<sup>15</sup> of sometimes ignoring the strategy He thinks the human is choosing even at the risk of seeming capricious. Brams' interpretation is that "we must pause to consider that if arbitrariness has a rational basis, incomprehensibility may have its place in a higher design."

As with many of the conclusions reached here, I find it unnecessarily pessimistic with respect to God (or any SB, for that matter). Brams makes it quite clear he does not examine traits such as benevolence, rectitude, or love here. I don't think this is exactly a failing of *Superior Beings*, but at least it begs the question of whether any such game-theoretic analysis is complete if one only examines the (vaguely Hellenistic?) "omni" attributes of God.

And that is where I think we must leave all three books. Especially with respect to the Bible and God, they are only starting points. Even if we acknowledge God as largely ineffable, He has made Himself known in Jesus, a real human with real motives and strategies – whether in the Temple knocking over the money-changers' tables or defeating Satan's temptations in the wilderness. God has chosen this, and given us the hope of possibly understanding God through Christ's life, death, and resurrection. If we are to be wise as serpents and not just innocent as doves, perhaps another look at mathematics born in the social sciences is in order – as another of our many tools of exegesis to understand the deepness of our God.

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<sup>15</sup> Similar calculations, using only linear inequalities, occur in any basic undergraduate game theory course.