Game Theory and Its Application to Divorce Settlement Negotiations

By KENNETH H. WALDRON

"Game theory" is a branch of mathematics that studies decision-making by people and entities in strategic relationships with one another, where the decisions of one have an impact on the other. Beginning with the study of parlor games, game theory principles have been applied to economics (five Nobel prizes), law, insurance, and war. Although the mathematics can be quite complicated, many of the concepts are simple and pragmatic and apply well to divorce settlement negotiations. We cannot hope to provide all of the principles of game theory in this brief article, but we will provide several basic principles that might assist in negotiations.

The game

A "game" is defined by its four components: players, rules, payoffs, choices and strategies. The *players* in divorce settlement negotiations are the two teams, each made up of a party and his or her attorney. The party has goals and payoffs. The attorney, who knows the rules of the game, helps the party remain a rational player. The *rules* are the statutory and case law, local rules, and the local practice culture. The *payoffs* are the values accrued by the party in the negotiations, which might be gains but also limitations on losses. Payoffs can include time with children, a certain

support amount and term, and desired property, but also can be a limitation, such as only having to pay a certain support amount when that amount was expected to be higher. In a sense, the difference between the expected support level or property division and the actual support level or property division is a payoff. A group of payoffs, as occurs in a marital settlement agreement, is called a "payoff structure." Finally, to be a game, the players must have at least one *choice* and, more commonly, a series of choices, which becomes a *strategy*.

The value in playing the divorce game well is in providing the parties with optimal payoff structures and substantially reducing the amount of conflict and disputes between them, which is particularly valuable when there are minor children involved and the postdivorce parenting relationship is critical to child adjustment and development. Applying game theory principles to divorce occurs in a larger context in which steps are taken in the analysis and planning prior to negotiations. These involve: goal-based planning, setting content and axiomatic standards, and effective information management.

Goal-based planning

Game-theory-based negotiations challenge four basic assumptions in traditional family law. First, legal outcomes are not viewed as goals; they are viewed as a short-term means for accomplishing the long-term goals of the parties. Second, the interests of the parties are not viewed in

opposition to one another. The parties' long-term goals for their children and their financial lives are likely more in concert than dissimilar. Third, the negotiation process is not seen as a conflict in which each party is seeking advantage; instead, the process aims at optimizing payoff value for *both* parties. This invariably includes some differences between the parties. However, the first stage of negotiations is a cooperative process, that is, a process in which value is increased for both parties, only moving to compromise when the goals of the parties have been optimized as much as possible. Fourth, game theory does not view divorce negotiating as a *zero sum game.* In a zero sum game, the pot is limited to 100 percent, and any advantage one party gets is a disadvantage to the other party.

Game theory research informs us that goal-based planning can produce payoff structures (the total of the payoffs in a settlement package), which yield each party up to about 75 percent of the total payoff value. Thus, a settlement can equal up to about 150 percent of the pot. In a split-the-pot game, a zero sum game, 100 pennies are on the table, and two players must split the pot. Thus, if one party gets 51 pennies, the other party gets 49. Game theory research tells us that many games that appear to be zero sum games are actually not zero sum games; instead, each of the parties can obtain up to about 75 percent of the pot. This is possible because both objective and subjective payoffs have value, with the subjective value often higher than the objective value.

The objective value might best be summarized by the question, "What do you want?" and "How much does it sell for on the market?" The subjective value arises when you ask the party, "Why do you want that?" or better "What are you trying to accomplish in the long run by obtaining that?" An auction illustrates this because players will often bid much higher than the "objective" value of an object because of the subjective value. An antique oak Globe file cabinet that holds no more files than a standard metal file cabinet costing $100 might sell for $800, because of the subjective value of the cabinet to the bidder. A first step in divorce negotiations is for each attorney to explore in depth with his or her client both objective *and* subjective payoff values and goals. Those goals set *content standards* against which settlement options can be measured.

The second step is to establish axiomatic or process standards. To optimize payoffs for both parties, divorce negotiations need to have standards set at the beginning to guide the decision-making process.

Five E standards

There are five game theory standards: (1) the clients are *educated*, particularly with regard to the implications of their agreements, both financial and with regard to their children's long-term adjustment; (2) the agreements reached are *effective*, that is, they accomplish the long-term objective and subjective goals; (3) the agreements are *equitable*, perceived by

Game Theory *Glossary of Terms*

Bayes' rule—suggests that when players gain increasing information from one another through negotiations, beliefs about the other party are updated and there is a convergence of expectations on solutions (i.e., settlement options).

Content standards—are the parties objective and subjective payoff values and goals.

Effective information management—is a guiding game theory principle, which applies throughout the entire negotiation process. Optimal agreements are reached when information is *public*, *verifiable*, *perfect,* and *complete.*

Five game theory or E standards—(1) the clients are *educated*, (2) the agreements reached are *effective*, (3) the agreements are *equitable,* (4) the agreements are *equilibrant,* (5) and the payoff structure in the agreement is *envy free.*

Game—is defined by its four components: players, rules, payoffs, choices and strategies.

Mixed game—is a game played as one game but for which there are multiple payoffs.

Multiple game—is a game that is played as though it is a single game but is really a group of individual games.

Nash equilibrium—combines a cooperative stage in which each party increases value for himself or herself and for one another, with a noncooperative or compromise stage that addresses any remaining differences between the parties by making obvious a point of equilibrium that drives the final compromises.

Normal form game—is a game played one time, with an outcome that has payoffs for the parties.

Payoffs—are the values accrued by the party in the negotiations, which might be gains but also limitations on losses.

Players—in divorce settlement negotiations players are the two teams, each made up of a party and his or her attorney.

Point of equilibrium—a point in negotiations where parties are satisfied that they have improved their payoff structure as much as possible, without diminishing that of the other, and can move on to the compromise stage of bargaining on any remaining issues.

Repeated form game—the focus is on establishing procedures to be used when a game node presents itself.

Rules—are the statutory and case law, local rules, and the local practice culture.

Simple game—is a game played for one or a group of closely related payoffs.

Strategy—The players commonly have a series of choices, which evolve into their strategy.

— K.H.W.

the parties as being fair; (4) the agreements are *equilibrant*, that is, the payoff structure for one or both parties cannot be improved without reducing the value to the other party; and (5) the payoff structure in the agreement is *envy free*, that is, while the parties have loss in the divorce process, both financially and with regard to their involvement with their children, neither party would trade his or her settlement package for the settlement package of the other party. These five E standards can best be met through a cooperative, rather than competitive, bargaining process.

Information management

Effective information management is a guiding game theory principle that applies throughout the entire negotiation process. Optimal agreements are reached when information is *public*—both parties have the information,

Use Game Theory *Tools*

Once the foundation is set for negotiating with good information management, a focus on the long-term objective and subjective goals of the parties, and on the axiomatic process goals of the five E standards, game theory provides tools to facilitate the negotiation process. Here we will address three tools: determining if the game is a normal form game, with a focus on content, or an extensive repeated form game, with a focus on procedures; separating multiple games into single games; and separating mixed games into simple games.

1. The different games.

A normal form game is a game played one time, with an outcome that has payoffs for the parties. Once played, the game is over. Many games involving the financial aspects of a divorce are normal form games. A game is played for the division of a bank account or a retirement account, and when complete, the game is over. An extensive repeated form game is a game that might be played at the time of a divorce, but this is just a "game node" in a game that the parties will continue to play following the divorce.

Parenting after a divorce and some forms of support are repeated form games. The node at the divorce with regard to parenting might be to determine legal custody and a residential schedule, but how decisions will be made is a repeated form game that the parents will be playing at least until the children are adults and possibly beyond that. Helping the child plan a wedding, for example, or keeping down the stress of holiday planning, could occur well into the child's adulthood. Even the residential schedule is likely to be modified and improved with changes as future circumstances develop. The quality of the coparenting relationship, which has an enormous impact on outcomes for children, is an extensive repeated form game.

A focus on content

In a normal form game, the focus is on the "content" of the issue. With a retirement account, the content might include the retirement goals of the parties, valuations, tax implications, and so on. In extensive repeated form games, the focus is on establishing procedures to be used when a game node presents itself. A procedure for parents to make future custodial decisions, for example, might be a six-step decision-making procedure with additional steps (e.g., a mediation requirement) should the parties be unable to arrive at an agreement after taking those steps. The coparenting game might include specific procedures for sharing information, managing transitions, providing telephone access, having flexibility in the residential schedule, and coordinating parenting across homes. Procedures for support without court involvement might include deadlines for sharing financial information, standards for when a change in support is warranted, and a formula for making those adjustments. By analyzing which games are normal form games and which are repeated form games at the time of the divorce, and negotiating a settlement that has a focus on both content and procedures, attorneys can better serve the long-term interests of their clients.

2. Multiple games to single games.

Many games in the traditional divorce process are multiple games. A multiple game is a game that is played as though it is a single game but is really a group of individual games. Many parties, for example, play the residential-schedule-for-children game as though it is a single game. One party might vie for an equal residential schedule, and the other party might vie to be the primary parent. Or they might even reduce it to a dispute over 7–7 or 50/50 percent versus 10–4 or 71/29 percent. However, developing a residential schedule for children postseparation is really a cluster of games. By separating the multiple game into single games, settlement options become much more apparent, and the focus shifts from the needs and interests of the parties to the needs and interests of the children. For example, using game theory principles, it is prudent to negotiate a residential schedule starting with a single game that has a good chance of being easily solved. For example, the

verifiable—either by document or because the source is trusted, *perfect*—both parties know the history of the game prior to making a choice (e.g., the objective and subjective goals undergirding prior proposals by the other party), and *complete*—both parties know the rules and payoff structures. This is another advantage to having attorneys involved in the divorce negotiation process, because the attorneys can elicit and share information, interpret the information from

attorneys might start with proposals for Mother's Day, then move on to Father's Day, then July 4th, etc. The focus is on producing a plan that optimizes the children's experience during each holiday and teaches the children valuable lessons (e.g., the importance of duty to others in relationships). At the beginning of each game, thoroughly exploring the objective and subjective goals of the parties is essential. Although more tedious than simply producing an alternating holiday template, playing these single games establishes a pattern of focusing on long-term goal-based planning for the children.

For example, before starting Christmas placement planning, attorneys might ask their clients what their goals are for their children with regard to the Christmases left in their control (e.g., with a nine-year-old, there are only nine Christmases left until the child reaches the age of majority or age 18). Those goals might include keeping certain family traditions (e.g., Christmas Eve with the extended family of the mother) or starting new traditions (e.g., a ski trip). One parent might want the option to travel to see extended family on three of the future Christmases Through this process, the

parents develop a pattern of focused goal-oriented planning, producing good Christmases, a process that will serve them well in the future.

Following the holiday planning, the parties could move on to the single game of vacation scheduling, with a focus on content (e.g., number and length of vacations) and procedures (e.g., notice period). The parties could then move to the single games involved in summer planning, both with a focus on content (e.g., how much time remains after vacations) and procedures (e.g., enrollment in summer programs).

Summer as multiple games

Summer might be multiple games, and playing the summer weekend game and then the summer weekday game might yield better results. The next game might be weekends during the school year and then days off school during the school year (e.g., teacher conference days). The final game could be school days, but even that might end up being a multiple game. There might be an after-school game, an overnight game, or an access game (e.g., taking a child to an activity). Single games are easier to solve than multiple games. In our earlier example,

a major dispute over 7–7 and 10–4 gets reduced to a difference of about 35 days per year by playing the non-school-day games first. A 35-day difference in positions is easier to solve than the major dispute between 50/50 percent and 71/29 percent.

3. Mixed games to simple games.

A mixed game is a game played as one game but for which there are multiple payoffs. A simple game is a game played for one or a group of closely related payoffs. Again, using the residential schedule for children as an example, obtaining a certain schedule can have many payoffs. Some payoffs are obvious, such as time with the children, an advantage in a potential relocation dispute, a school-choice advantage, and a child support amount. Other payoffs are subtler, such as status, a sense of fairness, minimizing the loss of the children, or even trying to win a spousal argument about who is the better parent. Simple games are easier to solve than mixed games. Playing the child support game separate from

the residential schedule game, while taking into consideration the costs associated with a particular schedule, makes resolution easier.

In one mediation, for example, the mother repeatedly accused the father, over his protests, of wanting to change the schedule to an equal-time schedule to save on child support. When I separated the two games, it became apparent that the mother's budget was dependent on the child support that she was receiving. It also became apparent that the father had an interest in the quality of the children's lives while at their mother's home. Once this information was available to the parties, the father agreed to continue to pay the same support if the mother agreed to change the equal-time schedule. These agreements optimized the outcome for both parties.

Likewise, a financial dispute over a family home might, with probing, be a mixed game with multiple payoffs at stake. Spousal support is often a mixed game (e.g., affording a mortgage, returning to school to increase future income, etc.), which is more easily and creatively resolved by separating the payoffs into simple games.

—K.H.W.

the other party more objectively, and educate their clients on the rules and payoff structures that they are developing in the settlement.

Bayes' rule

One way to achieve good information management and elicit the objective and subjective goals of the parties is by enlisting Bayes' rule. Bayes' rule suggests that when players gain increasing information from one another through the negotiation process, beliefs are updated and there is a convergence of expectations on solutions (i.e., settlement options). One way to achieve this is by taking turns making proposals and including in the proposals the subjective goals of the person making the proposal. For example, what might start out as a dispute over which party will obtain the family home, with a sharing of information about the subjective goals and taking turns on proposals, might be settled by selling the family home, with both parties buying more modest homes near one another in the same general neighborhood and school district. The goals of the parties might be the same, that is, keeping the children in the same neighborhood and school and staying actively involved in all aspects of the children's lives. As the parties learn that their goals are the same, their expectations converge on the pragmatic task of accomplishing those goals, which could include neither one keeping the family home.

Game theory bargaining presumes solutions

A number of solution theories have been proffered by game theorists for different types of games and games of increasing complexity. John Nash, of *A Beautiful Mind* fame, developed a solution to games, called the Nash equilibrium, which combines a cooperative stage in which each party increases value for themselves and for one another with a noncooperative or compromise stage that addresses any remaining differences between the parties

by making obvious a *point of equilibrium* that drives the final compromises. Bayes' rule plays an important part in reaching that point of equilibrium. The *convergence of expectations*, achieved as parties update their beliefs, helps identify the solution to the game, even when narrowed to a remaining difference.

Cooperative and compromise bargaining

Game theory negotiations achieve optimal outcomes when the parties first bargain cooperatively, each attempting to improve the payoff structure for themselves *and* for the other party. By updating beliefs with increasing information about the objective and subjective goals of the parties, each party is able to make increasingly valuable proposals. The mindset at this point in negotiating is

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to continue to try to improve the payoff value to both parties, or at least for one party, without diminishing the payoff value to the other party. Only when satisfied that the parties have improved the payoff structure as much as possible to each of them, without diminishing that of the other, do they move to the compromise stage of bargaining on any remaining differences. Here, compromise and trade-offs identify the point of equilibrium or solution. A remaining difference of $100 in support, for example, suggests $50 as a point of equilibrium. In an earlier example, the father paying current child support levels, while gaining an equal time schedule is an example of a trade-off point of equilibrium.

Once the settlement package has been reached, it might be tempting to settle and sign, perhaps thinking that the settlement is fragile. However, this is the time to measure the settlement against the two sets of standards: the *content standards* (the goals of the parties) and the *axiomatic standards*. If the settlement does not meet the five E standards, for example, the parties might do better to backtrack and adjust the settlement. When the resources of the parties allow, it can also be helpful to submit the settlement to an expert or a neutral third party to see if the payoff structure can be improved. A financial settlement, for example, submitted to an accountant, might be restructured and improved for at least one party without hurting the other party. Improving the settlement for *both* parties would be a win-win.

Game theory is not a means for gaining an advantage in hardball negotiations. It offers a perspective and tools

to facilitate optimal outcomes for both parties, which are particularly helpful when children are involved. The presence of attorneys on the teams adds objectivity, knowledge, and rationality to the game, enhancing the probability of optimal outcomes, but only if the attorneys challenge the more competitive assumptions of traditional law.

Game-theory-based negotiations have another benefit to divorcing spouses who are going to have ongoing involvement with one another, particularly when children are involved. Traditional law models a competitive and ultimately destructive process to families: taking short-term positions on issues, bolstering one's position, undermining the other position, and negotiating with the goal of winning. In game theory, this is known as the grim strategy.

In other words, traditional divorce law promotes (or at least facilitates) relitigation. Game-theory-based negotiations model identifying long-term objective and subjective goals, looking for optimal solutions for both parties in a cooperative discussion with good information management, narrowing the unresolvable differences, and looking for either a compromise or trade-off point of equilibrium. The latter is much more conducive to healthy family functioning and provides a better model of good problem solving to children. **FA**

KENNETH H. WALDRON, PH.D., is with Monona Mediation and Counseling, LLC. His practice for more than 35 years has been devoted to family law. His focus on the theoretical underpinnings of intractable conflict between separated spouses has undergirded his work with coparenting problems, child estrangement, and other conflict problems in families.

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