12 Social distinctions for decision processes

In this chapter and the last we continue our analysis using specific numerical models to understand the new distinctions that arise in the *decision process theory*. Some of these distinctions are physical, which we dealt with in the last chapter. Some of the distinctions are more social, which we deal with in this chapter.

12.1 *Code of conduct*

With the distinction of a ***code of conduct***, we make another significant departure from *game theory* and other economic theories (section 7.2). A code of conduct provides preserved and conserved cooperative behaviors. From a *network connectivity* view, there are no gradients or change between one area and another. It is a possible symmetry of the solution and any decision process may have such solutions. We use such symmetries to define what a player is and extend it to define cooperative behavior where certain strategies are removed from the competitive context by agreement of the players. There are clearly hints of this type of distinction in (Von Neumann & Morgenstern, 1944). Those hints however have not been exploited to the same extent as here. The existence of a *code of conduct* changes the essentially *greedy* nature of game theory and puts honoring a contract on the same footing as other components of the theory. It is a possible and stable way to play the game. It is an important assumption of (Smith, 1776) to support the *invisible hand*.

The type of cooperation we have in mind is more along the line of coalition rather than consensus (section 7.6). All players benefit for example in a solution in which contractual agreements are honored, despite the possibility that individual gains might be achieved by not so doing. The contract must be honored even for those choices in which a significant advantage would be obtained if the contract were violated. We are not saying that all solutions require that contracts be honored, only that that there is one such totally acceptable solution. We have explored in detail the prisoner's dilemma (chapter 5), which provides an example of a *code of conduct*: in this case a code of silence. We think the possibility of such coalitions occur frequently. We have also explored a much simpler *code of conduct* in chapter 8, an overall player preference scale: behaviors are driven by skill not by the sum of resources expended by all participants. A *code of conduct* behaves as a fictitious player as in Figure 11-3 through Figure 11-6.

Our view is that decisions occur not only in a survival of the fittest context but in a societal context. Human beings are social beings as well as competitive beings. That means they are as likely to follow ethical norms as to work towards maximizing personal gain. A *code of conduct* provides an important dynamic mechanism for incorporating the societal context. It exists in the real world and so it should be part of any theory describing that world. We suggest that solutions not only be utilitarian but just (Tavani, 2011). Of course this is not a requirement. Just as in engineering, we can build structures that serve human needs and those that don't; decision process solutions may equally meet or fail to meet human needs. The choice of solutions remains subjective.

As an example, consider two global companies. One might create and adhere to a *code of conduct* in which bribery is expressly forbidden, even in countries where it might be the practice. The other company might not have such a code of conduct, or at least its code of conduct remains silent on this issue. Both companies might prosper, though possibly in different ways. The first company would seek revenue opportunities in countries where taking bribes is not practiced, or might if practiced succeed because of a superior product. The second company might seek revenues everywhere and turn a blind eye if bribes are required and employees comply.

In realistic solutions, it is hard to imagine that there won't be some set of strategies that will be excluded from the competitive arena. In the market place or in war there always appear to be ***rules of the***

game that have been adopted and are followed. A *code of conduct* is not just an interesting dynamic possibility but a required dynamic mechanism for describing decision processes. An important step in studying any decision process is to identify the operative *codes of conduct*. It partitions the strategies into those that are ***active*** from those that are part of the *code of conduct* and ***inactive***.

A criticism of this approach might be the accurate observation that in practice, few if any *codes of conduct* are adhered to all of the time. Any set of ethical rules, regardless of how noble, are usually violated from time to time. Depending on the rules, the violations may be small to large. The attempt to curb alcohol consumption during prohibition was met with scant success. However, deviations from the expected mechanism in fact provide a strong support for the dynamic point of view that we take. The *code of conduct* mechanism is a presumed symmetry. It provides reasonable solutions as an approximation. We can always remove the symmetry constraint and study the behavior of the system over time assuming the system is adjusted to perfect symmetry on some boundary condition. We are then in a position to study whether the symmetry is reasonably stable or dramatically unstable. In effect we study the effect of the other dynamic mechanisms on our initial symmetry.

More generally, it is our view that each dynamic mechanism has an area of applicability in which the mechanism is clearly visible. All mechanisms interact through the theory, which predicts breakdowns. Our example of the late project (section 11.2) was an example of both a mechanism for delivering the project on time and the impact of late requirements that generated a significant delay in delivery. Although we argue that there is always a *code of conduct*, it may not be totally effective, depending on how hard it is to enforce. We can treat it as an exact symmetry or study the symmetry breakdown depending on our judgment of its effectiveness. As part of that study, we might consider steady-state harmonics that depend on that variable just as we consider steady-state harmonics that depend on time. In both cases we are studying the acceleration effects in frames in which the symmetry is not apparent. It is a prelude to considering the most general case of transient behaviors.

12.2 *Entitlement*

We contend that each player has effectively two views of the decision process. In one view the player makes choices depending on the current collective behavior, the *characteristic payoff*. In the other view, the player makes choices depending purely on their own worldview; they are empowered without regard to other player behaviors. In a positive sense of the word, they act with ***entitlement*** (section 8.8). They believe they have a right to make their own decisions and manage their own interactions. They forcefully state their position in making their decision. *Entitlement* is the self-centered and egocentric component, though without the intent to necessarily harm others. *Entitlement* doesn't take into account the other point of view. In a societal framework, even if *entitlement* effects are *stationary*, we expect them to reflect *network connectivity* gradients (*Cf.* Figure 12-1 and Figure 12-2 below).

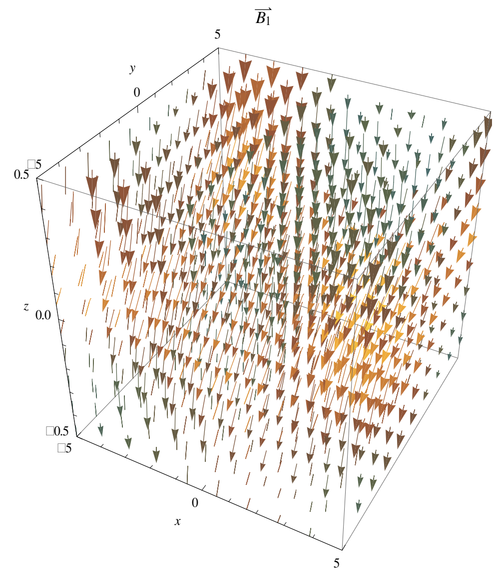

Figure 12-1: "Defense's" view (blue) $\vec{B}_1(x, y, z)$ of payoffs in co-moving frame

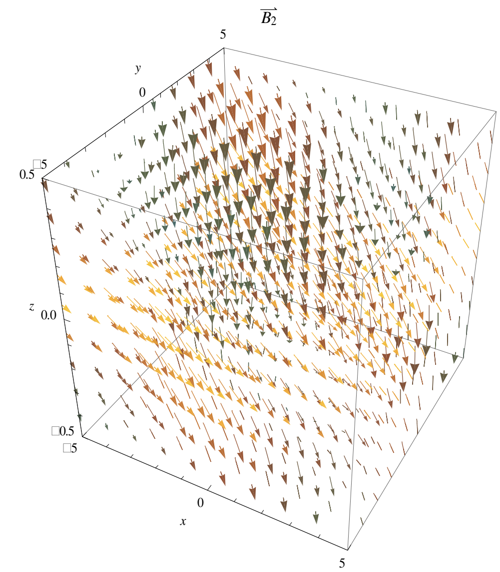

Figure 12-2: "Attack's" view (red) $\vec{B}_2(x, y, z)$ of payoffs in co-moving frame

We expect that in every decision process, each person puts forward their best argument in support of their personal view. In our theory, each player's personal view is their worldview as expressed in the payoffs they expect. Because we take a dynamic view, we allow for that payoff to change with time or across the network. The possibility of a learning curve in space and time is a necessary attribute of *entitlement*. In our models, we have primarily focused on models in which the learning curve is in space not time.

In some extreme cases only the *entitlement* view is present. Consider political parties as players. It is not uncommon for a political party to portray only their view and make decisions solely on that basis. In other extreme cases, only the other view is present. Consider a family. The parents often take only the "other" view. They try to do what is best for the children, sometimes at the expense of their own welfare. In general, it may take effort to identify the component of the payoff that truly represents the player's current best interest.

This type of split of the player payoffs seems to have no parallel in *game theory*. The split is blurred by the process of looking for an equilibrium state. It is clear however that a dynamic split must exist, that the split changes in space and time and that the split benefits from the learning curve. If we return to the example of the political parties, there is no long term future for either party to stubbornly maintain their entitled position and hope at the same time to pass legislation if they exist in a two party system. Moreover, even if they have a stubborn ideological split, it may not be on all issues. So either their entitled position evolves, they adopt a position (or work in a strategic area) that has some composite support or some combination of both.

Let's return to the example of the software project. The customer and the company start with a view that is probably aligned. They both expect the delivery of the project in two years and they both agree on the price of the project (customer) and the cost (company). They have differing entitled views however on things that don't directly concern the other. The company expects to roll off its developers onto a new release that will be for a new customer once the project is complete. The customer has hired marketing and a roll out crew to introduce the new product to its customers. This rollout is predicated on the delivery date. If the delivery date is met or is close to being met, neither party has an issue since they have built in a little slack in their schedules based on their experience.

The introduction of the new features and the addition of new costs and pricing were based on the old model for each. Neither changed their fundamental notion of what would happen. The company was probably the first to realize that its view of the world was wrong. After all it was not going to deliver on time. It was hiring more people than anticipated and was forced to rearrange its development schedule for other customers. It had learned the error of its ways; the new hires were not prepared to deliver as planned and the number of hires made was insufficient for the task.

The customer however was going on without much warning that things were not proceeding as planned. Its worldview remained unchanged. It was getting reports that there were a few glitches but the company was doing everything it could to deliver. So the customer proceeded to do its hiring and getting its marketing campaign in place. At some point however the customer was told that delivery was not just a little late; it was very late. The customer's view was now badly out of whack with reality. The learning curve of exactly what had transpired was now fully operative.

Both the customer and the company would now have to address their entitled worldviews and continue to make changes until a new working arrangement could be forged. What is clear is that at each stage they have a selfish view of what they want and a less than realistic view of the obstacles in the way of achieving their goal. We require our theory to provide a model of this transitional behavior, such as for the attack-defense example, Figure 12-1 and Figure 12-2, which is internally consistent. To do so we need to expand out discussion to a related dynamic distinction, the player's engagement or coupling to the *composite payoff*, which we do in the next section.

12.3 ***Engagement***

The coupling (charge) or ***engagement*** to the *composite payoff* is a new dynamic distinction. We touched it briefly in section 11.3 in our discussion of the *active strategy* of *aggression*, Figure 11-5 and Figure 11-6. Engagement is an *inactive strategy*. The product of the *engagement* and the *composite payoff* is one component that governs a player's choice. This component and the *entitlement* component add to produce the observed player payoff. We have to include all the players and any *codes of conduct* (which we treat as players). The *code of conduct*, as in the attack-defense model, Figure 12-3, may look nothing like the payoffs of the players. It may also have initially a larger coupling, though this may not be true generally, as in Figure 11-5 or Figure 11-6.

If there is no *engagement* then the player payoff is all *entitlement*. If there is no *entitlement* then the player payoff is determined by the *engagement* to the *composite payoff*. The theory produces this model with two mechanisms and allows us to study their mutual interaction. The composite behavior of all the players determines the *composite payoff*, such as Figure 12-4 for the attack-defense model. We hope to establish that certain dynamic mechanisms exist in the real world and that these mechanisms play a key role in decision process theory. We then have an argument for why we should apply a dynamic theory to explain the interactions.

We argued above that we can identify when *engagement* is zero and so identify when the player behaves in the extreme case of acting *entitled*. These cases establish that there is an effective dynamic mechanism of *entitlement* behavior. We now want to establish the other case: a player recognizes that there are payoffs agreed to by all parties and buys into that by aligning his or her own worldview to that payoff scheme, to the *composite payoff* (such as Figure 12-4). This is not the same as a *code of conduct*. The player makes no commitment to a specific strategy, only an acceptance of what appear to be the rules of the game in terms of who wins and who loses and what payoffs occur in each case. This is the opposite case of the player paying no attention to what others appear to be accepting as the rules of the game and acting based on their own sense of *entitlement*.

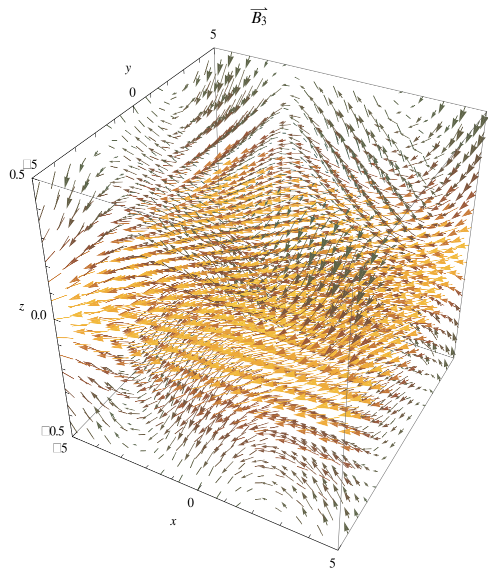

Figure 12-3: Attack-defense code of conduct payoff $\vec{B}_3(x, y, z)$

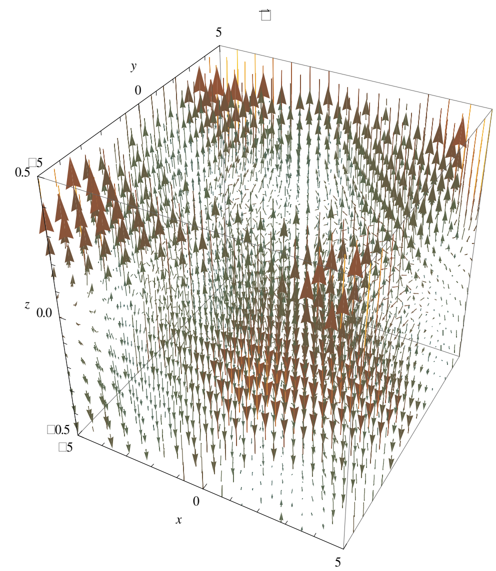

Figure 12-4: Attack-defense collective composite payoff $\vec{\omega}(x, y, z)$

There are many examples in which engagement appears to be the primary dynamic mechanism. We provided an example of why people queue up for tickets in section 7.2 as an example of a particular *code of conduct*. Here is a slightly different story of queuing that illustrates *engagement* rather than *code of conduct*. Some years ago I was in Leningrad, as it was called then as it was part of the Soviet republic. Trading on the black market was apparently very common. I observed that no matter the time of day, when walking down main streets I came across people standing in long lines. I asked someone about them. He told me the following story. A man saw one of these long lines and immediately joined it at the end of the line. After standing there for a few minutes another man did the same thing and then after a few minutes, asked the first man, “what are we in line for?” The first man answered, “I don’t know, but whatever it is it must be great because the line is really long.”

We think of *engagement* as providing that coupling to the collective worldview of what constitutes payoffs for the decision. That collective worldview is likely to differ from the individual’s *entitlement* worldview. The more engaged we are, the higher we value the *composite payoff*. We have focused in this book on processes in which the *engagement* and *composite payoff* are *stationary*, but have non-trivial network connectivity. However in general, both the *engagement* coupling and the *composite payoff* are dynamic in space and time. Thus in the example of the software development project, the initial *composite payoff* reflected the successful delivery of past software releases to the customer and so also reflected the successful sales of the company’s product to this customer.

It is not clear however that this represents strong *engagement*. Indeed, we think it may represent the opposite. We argued that both the customer and the company internalized behaviors so that their *composite payoff* view represented how they viewed the transactions. Fortunately for both sides these two views were the same. The *engagement* we argued was probably zero and their entitled payoffs proportional to the *composite payoff*. This is supported by the fact that as soon as the situation changed, neither side anticipated any change to the basic rules and payoffs. Their *engagement* was initially zero. They made their plans based on their internal entitled view, which ceased to match the *composite payoff*. Only after some time did it become apparent that there was a problem. The *engagement* of each was no longer zero and as a consequence both sides adapted to the change based on their level of *engagement* to the problem.

I came across engagement as a dynamic mechanism in a management seminar that focused on Lincoln (Phillips, 1992, p. 121). The seminar recounted that during the Civil War, Lincoln believed that his generals were not sufficiently engaged. In one example, General McClellan, with a large army, met an advance by Robert E. Lee in 1862. Although Lee was outnumbered two to one, he inflicted heavy losses on McClellan's troops after which he then retreated across the Potomac River pursued by McClellan's superior numbers. McClellan did not pursue, claiming victory. However, Lincoln believed that McClellan had only defended his ground and had failed to engage. Lincoln replaced him.

Engagement is because it provides a mechanism for the decision maker to react to the other decisions that are being made. There will always be a *composite payoff* based on the decisions that have been made. To fail to respond to those can at times be disastrous, possibly to one's career.

12.4 ***Player interest***

A player may not always be engaged. The ***player interest*** for each particular strategy changes a player's *engagement* and generalizes the notion of value from *game theory*. Thus player interest is based on the network gradient of player engagement. Value as usually understood in game theory is the same regardless of strategy: when there is equilibrium there is the same *player interest* for any strategy chosen. This does not reflect the general case in which the player interest may differ from one strategy to the next. The source for *player interest* is the ***buy-in*** expressed by the overlap between the player's *entitlement* payoff and the common *composite payoff* (section 8.4). Not only does *player interest* change a player's *engagement*, the product of the *entitlement* payoff and *player interest* contributes the ***player impact*** to the *composite payoff*. *Player interest* is in a pivotal position in our theory.

Interest reflects a player's disposition to a particular strategy at the moment. For example in our example of a queue (section 1.1), a person stands in line because of interest. It is not based on knowledge of the consequences. Standing in line does not reflect a decision to purchase something that might be sold to someone who gets to the front of the queue. It reflects a spatial gradient: an interest to adapt to social pressure.

Interest often occurs when we are on autopilot. We are content with a particular set of strategies that have been successful in the past, as in our software development example (section 11.2). New circumstances may remind us of companies that have been in similar circumstances. We become interested in particular strategies as a consequence. Thus our interest is encouraged or fed by the fact that our decision processes occur not in a vacuum but in a society of other similar processes. We respond not only to the causal nature of our own experiences but to nearby societal or network experiences that are occurring simultaneous with ours. These are new effects not ordinarily considered in economic or game theory deliberations. They have been discussed in the literature however; see (Gladwell, 2005).

Being on autopilot relative to a particular strategic direction suggests that along that strategy and across the network, there are no variations of any quantity we choose to look at so that there is no reason to pick one region of the network over another. This is the requirement for a *code of conduct*. It is variations in at least one quantity that break a *code of conduct.* One possibility is that that quantity is the *player interest*. Thus the situations in which a contract is not honored (section 7.11, exercise 1) or a case in which resources of the commons (section 7.2) are being exploited or the prisoner's dilemma paradox (chapter 5) are all cases that may bring forth a *player interest*.

Like the *composite payoff*, *player interest* reflects the decisions and payoffs at that point. The *player interest* can be characterized as a payoff between the idiosyncratic *inactive* worldview strategy and an *active* strategy. Like payoffs in general, *player interest* reflects the potential for change. For this reason it is an important attribute to identify and quantify. We expect to measure it based on its effects on the engagement coupling. It is significant that player interest is associated with engagement and with adaptive change to social pressures. The interest in a strategy is based on the social attraction.

As a social attraction, we expect that *player interest* to be a source for change to the player *entitlement*. One measure might be whether the direction of player interest is parallel to an equilibrium direction of the *composite payoff*. If not, then the *player interest* ***challenges*** the *entitlement* payoffs to change. Such *challenges* generate network changes to the *entitlement.* In addition however, there can be more selfish forces that change *entitlement*.

12.5 *Player passion*

Besides being attracted to a particular strategy for a social reason, a player may be attracted for selfish reasons. An example is a ***player's passion*** for a particular strategy, which may overpower objective choice and also determine *entitlement*. The concept here is analogous to stress in physics as opposed to strain. It represents a force. We expect a strong *player passion* to influence initially the *entitlement* payoff. We view *player passion* as a stress on the system associated with a player and pointed in a particular strategic direction. This is similar to the *challenge* generated by the *player interest*. The difference is that the *player passion* is self-centered and the *player interest* is socially centered. For the *ownership model*, both contribute to the entitlement payoffs and can be different, *e.g.* Figure 12-5 and Figure 12-6.

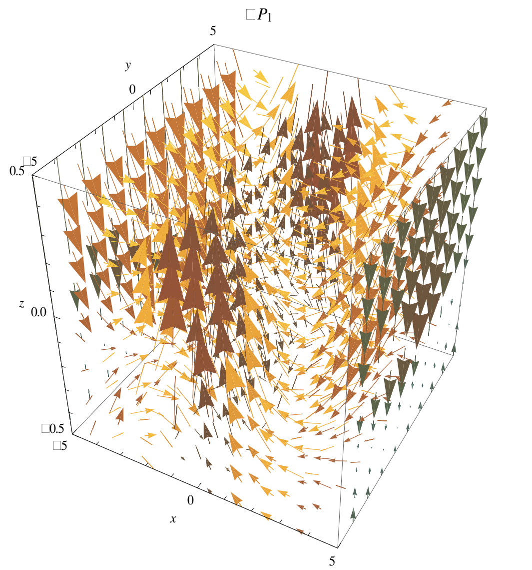

Figure 12-5: Blue "defense" passion gradient field $\nabla P_1(x, y, z)$

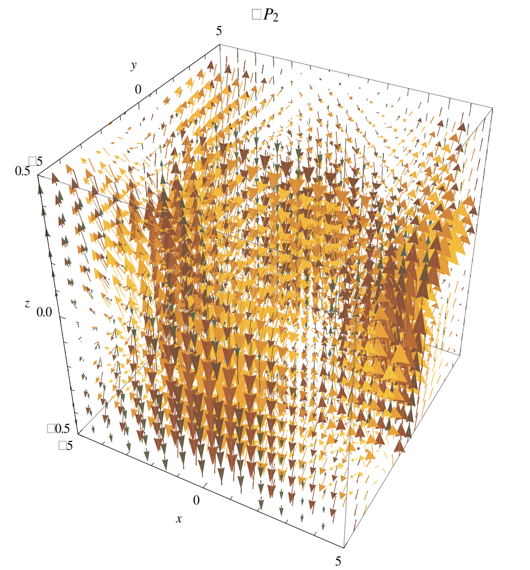

Figure 12-6: Red "attack" passion gradient field $\nabla P_2(x, y, z)$

We think that there are many examples of *player passion*. A strong belief in a cause can be characterized as a *player passion* for a specific strategy. It makes perfect sense that the *entitlement* payoffs seen by a person with such a cause will be determined by that passion. We suggest that charismatic leaders generate such *player passion*.

Though we expect *player passion* to significantly impact the *entitlement* payoff, in general it will not impact the *composite payoff* unless there is a strong *engagement*. We suggested this earlier by noting our expectation that impact on *composite payoff* would be made when the product of the *player interest* and *entitlement* payoff was significant. We think an equivalent measure is the product of the *player engagement* and *player passion*. A strong impact is made if a player is both passionate and engaged; in other words if the player pays attention both to those things they care most about and at the same time pay attention to those decisions that have the most social interest.

12.6 *Mutual player support*

The idea that players may interact with each other outside the confines of the decision process was necessary in the original theory of games (Von Neumann & Morgenstern, 1944). That proposal however was found to be flawed (Cf. the discussion in section 7.6). We replace that concept with the idea of *cooperation potentials*, which we refine here as ***mutual player support potentials***. Though the *mutual* *player support potentials* are specific to *decision process theory*, we see some similarity between them and the imputations and side payments introduced by (Von Neumann & Morgenstern, 1944). They are payments outside the framework of the competitive valuations of the forces as measured by the payoffs. The difference is that these side payments are attributes of the theory constructed as a self-consistent mathematical framework. They are not attributes outside the theory even though they reflect what can be viewed as psychological inputs to the decision process.

Moreover, they are necessary attributes of the theory that follow directly from our formal characterization of active and inactive strategies. These potentials reflect that in a decision process, players may change their payoff strategies as a consequence of the support potentials, which act as mixing terms. For example, the mixing changes the payoffs and the passions for one player as a function of payoffs and passions of another player by Eq. (8.24) and Eq. (8.25) respectively. Similar results hold for engagement, Eq. (8.29), and interest, Eq. (8.23). These are special cases of the general results for the *fixed frame model* solutions that are summarized in Table 4-1, Table 4-4, Table 4-5 and Table 4-6 in chapter 4. If there is no mixing, then each player makes choices that depend only on information available to all, such as the acceleration: the choices are idiosyncratic. Mixing is the essence of cooperation in that it is not idiosyncratic; it requires the players to make an agreement. The agreements occur between each pair of players. The *mutual player support potentials* determine the fractional change to what would otherwise be idiosyncratic attributes.

It becomes important therefore to identify *mutual player support* in practical situations in order to set the amount of mixing that occurs at an initial point. Before looking at the practical aspects, we briefly recall some theoretical aspects and set the distinctions that we will use.

We have isolated three components of the *active geometry acceleration* Q_υ in Eq. (11.1) that may force strategic behavior: an ***absolute force*** q_υ, a ***competitive valuation force*** $I_{\upsilon\alpha}e^\alpha$ and a ***cooperative support force*** $\omega_{\upsilon\alpha\beta}e^\alpha e^\beta$ (*Cf.* section 7.6). *Game theory* focuses on the *competitive forces* and considers behaviors that are in equilibrium under them. However, we think that decisions require knowing all three components for a given choice. Decisions require knowing that a given set of choices has ***mutual player support*** as measured by the *cooperative support force* above. We suggested above that a measure of the ***mutual support potential*** is the co-moving frame potential $\omega_{\upsilon\alpha\beta}$. This is a quantitative test for whether competitive forces are sufficient. If the *mutual support potential* is zero between two players then there are no *cooperative support forces* accelerating the strategy choices.

The *mutual support potential* may be non-zero as well. In particular there are ***player self-support*** forces possible, which will be non-zero only when the *player engagement* is non-zero. At the *still point* these forces may thus vanish. When these forces are non-zero, they may effectively balance the *absolute forces*. In particular we think of the sum of the *self-support forces* $\frac{1}{n_i}\Theta_\upsilon h_{\alpha\beta}e^\alpha e^\beta$ as playing this role. The sum contains the *self-support* for each player. The remaining contribution to the *cooperative support force* is the shear term, $\sigma_{\alpha\beta}e^\alpha e^\beta$. For the *fixed frame model* solutions, the shear tensor is a diagonal matrix or a constant rotation of a diagonal matrix. If diagonal, then only *self-support* terms exist. If a constant rotation of a diagonal matrix, then by a suitable redefinition of who is a player, we have only *self-support* contributions from composite players. However in the latter case, from the "real" player's perspective, there will be cooperative forces. This process was carried out for the attack-defense model and we did find cooperative effects between red and blue. More generally however, we argue that decision process theory need not make the *fixed frame model* approximations and that for more general solutions we will get still richer cooperative behaviors. However, we think it significant that cooperative behavior is a feature of the solution even in our *fixed frame model* approximation.

Note that the *mutual player support* distinction is distinct from the *code of conduct*, those as a mechanism it has the same origin: the existence of an isometry or inactive strategy. Players are not making a pact about adhering to a particular set of strategies. The *mutual player support potentials* are payoffs that drive actions by changing payoffs and passions. Indeed in the attack-defense model, the payoffs of the original model determined the *mutual player support potentials* between the *code of conduct* player and each of blue and red. Note that in this case each player can in fact determine the support potential between himself and the *code of conduct* player.

We also note that the mutual player support is another word for player bonding. There is a force due to the matrix of potentials whose surface normals describe the strength of bonding between individuals. Such bonds provide gradient forces dictating how players respond to cooperative forces. Gravity and centripetal acceleration are both examples from physics of ***bond forces***.

12.7 *Hidden-in-plain-sight*

Ordinarily, we take business cycles, seasonal cycles, etc. as effects for which we find compensations. We quote company profits by month, taking out the fluctuations that we know are there because of seasonal buying. In this way we hope to get an accurate picture. Such a picture is effective in a statistical model; in a causal model time dependent effects can create qualitatively new phenomena, such as the rotation of the earth and its effect in creating weather patterns via *Coriolis* forces. In *decision process theory*, we expect that cycles are ***harmonic steady-state waves*** that can't be factored out and must be incorporated systematically into the solution. An important sub class of such cycles consists of those that are ***hidden-in-plain-sight***, cycles whose existence we are not aware of yet ones that play an important dynamic role.

For example, in our daily life, there is one obvious *hidden-in-plain-sight cycle*: the "daily" part of "daily life". We make decisions each day assuming that the "daily" part of that cycle plays no critical role. In a public corporation, there is a quarterly cycle that is the *hidden-in-plain-sight cycle*. Each quarter, profits or losses must be announced. This drives behavior and can be taken into account in *decision process theory*. These *hidden-in-plain-sight* cycles are not seen; they are part of the background noise not because they are small or unimportant, but because they are so pervasive they are not noticed. The earth's rotation is a *hidden-in-plain-sight* cycle. Sunrise is in plain sight every day yet the relationship between sunrise and the earth's motion is hidden. Once the relationship has been pointed out, it becomes totally obvious.

We expect that the addition of *hidden-in-plain-sight* cycles may amplify effects that are already present. We suggest evidence for this in exercise 1. We do expect such effects to be present in the real world. Consider the effect of an advertising campaign. We run an ad daily for a particular product. The target audience for that ad listens to the ad daily and also makes buying decisions. We suggest that the effect of the ad campaign is subtle. The target audience has items it might buy and will do so according to preferences. The ads however may impact the timing of the buying, which may change the observed payoffs. The ads also skew the actual buying power.

We suggest that such small skewing behaviors can nevertheless generate effects analogous to tornadoes and hurricanes if left in place for long periods of time, analogous to the earth's rotational role in generating prevailing winds and storms. We suggest the need for different ways of looking at decisions to make such hidden behaviors more accessible. In exercises 2 and 3 we introduce the notion of ***decision isobars***, analogous to weather isobars, as one new way of looking at decision processes.

These exercises also illustrate the possibility for additional hidden cycles; in this case associated with the model assumption that the exact coordinates y^{υ} are cyclic. The meaning of such an assumption is that strategies are essentially constrained as if in a box. The strategies don't deviate significantly from the mean as seen in the co-moving frame. This assumption does correspond and generalizes the notion that behaviors occur near some equilibrium without making the assumption that behaviors are in fact static. We provide further evidence of this in exercise 4.

12.8 *Outcomes*

In this chapter we identify new distinctions generated by *decision process theory*:

1. ***Code of conduct***: Preserved and conserved cooperative behaviors.
2. ***Entitlement***: A player acts alone, empowered without regard to other player behaviors; egoistical behavior. This is the first component that governs a player's choice.
3. ***Engagement***: The coupling or ***engagement*** to the *composite payoff* is a new dynamic distinction. The product of the *engagement* and the *composite payoff* is the second component that governs a player's choice.
4. ***Player Interest***: The *player interest* for each particular strategy changes a player's *engagement* and generalizes the notion of value from *game theory*.
5. ***Player Passion***: A player's passion for a particular strategy may overpower objective choice and determine entitlement.
6. ***Mutual player support***: Decision processes are governed in part by player cooperation driven by *mutual player validation forces*, which play as important a role in governing behaviors as do *competitive valuation forces*. This depends in part on a matrix of potentials whose surface normals describe the strength of bonding between individuals. Such bonds provide gradient forces dictating how players respond to cooperative forces. Gravity and centripetal acceleration are both examples from physics of ***bond forces***.
7. ***Hidden-in-plain-sight***: In *decision process theory*, we expect that some *harmonic steady-state waves* may be aspects of cycles that are *hidden-in-plain-sight,* cycles that needs to be incorporated systematically into the solution. Until now, such effects are unseen; distractions we remove when we attempt to see the big picture.

The student should be able to identify these distinctions in real world decision processes and qualitatively see how such distinctions would apply in the theory. The attainment of the outcomes of this chapter is facilitated by doing the exercises in the following section.

12.9 *Exercises*

1. We take our *free fall* model for attack-defense, section 11.9, exercise 8 and add a small amplitude *harmonic* with frequency $1/4$, weight as in Eq. (9.11) from exercise 7, section 9.5, along with the coefficients of the *harmonics* set in the same way (the numbers will be different since the *free fall* component is different). We compare the contour flows before (Figure 12-7) and after (Figure 12-8) the *harmonic* addition. Notice the size of the flows has expanded. Are these new effects or have existing effects just been amplified?

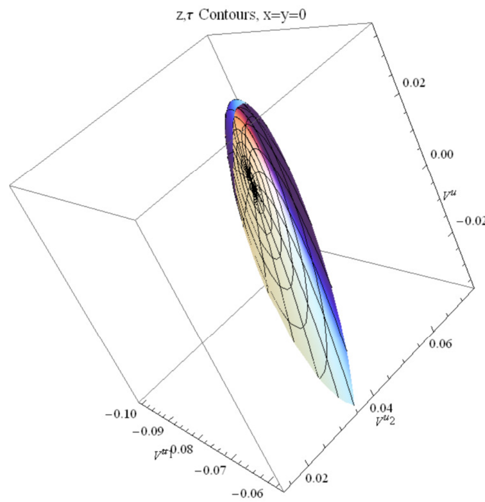

Figure 12-7: Contour *free fall* flows

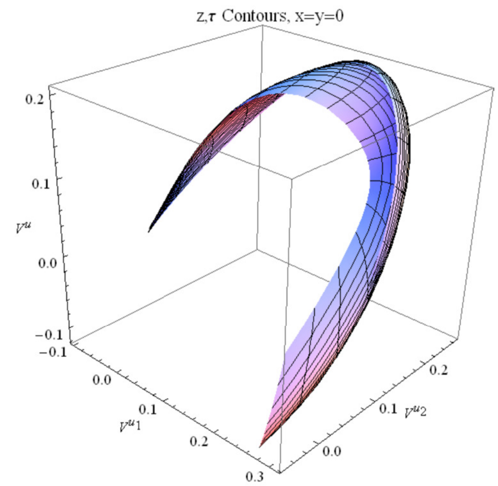

Figure 12-8: Contour flows, *free fall* with small *harmonic* addition

2. *Hidden-in-plain-sight cycles*: In meteorology, hidden cycles are made visible by "abstract" contour plots. One such popular plot consists of pressure contours or isobar plots. They help vision the behavior of the weather which would otherwise be hidden phenomena, based on cycles that are ordinarily ignored such as the rotation of the earth. We take the model from exercise 2 and plot ***strategy contours*** for fixed values of $\{z \quad \tau\}$, Figure 12-9. The situation is more complex than the usual meteorological plots, but there are some similarities. For example we display the ***decision isobars***, Figure 12-10. Based on the model parameters, discuss the significance of the assumption that there is an initial aggression gradient.

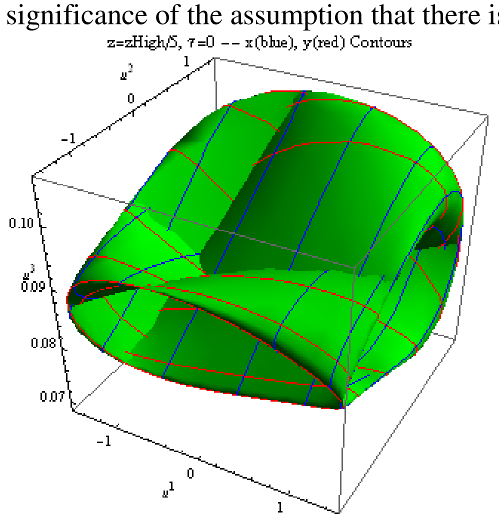

Figure 12-9: *Strategy contours* $\{x \quad y\}$ **with fixed** $\{z = 1/10 \quad \tau = 0\}$

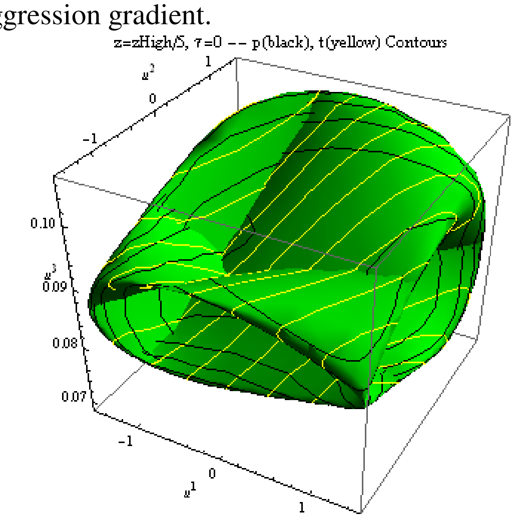

Figure 12-10: *Decision isobars* $\{p \quad t\}$ **with fixed** $\{z = 1/10 \quad \tau = 0\}$

3. Given the complex nature of the calculations that lead to the contours in exercise 2, it is useful to have alternate ways to envision the model results. We consider the pressure for fixed values of $\{z \quad \tau\}$ plotted against the defense-active proper strategies $\{x \quad y\}$ at $z = 1/10$ and two different values of proper time, Figure 12-11 and Figure 12-12. Also shown are the pressure plots at $z = 2/5$, for two different proper times, Figure 12-13 and Figure 12-14. The horizontal axes are the

strategies for defense and attack. These surface plots are easier to produce than the more direct plots based on a fixed aggression u^3 and a fixed time $u^t = t$. Based on the behavior of the plots provided, discuss what you expect for the more direct plots. Can you see evidence of this hidden behavior in real world decision processes?

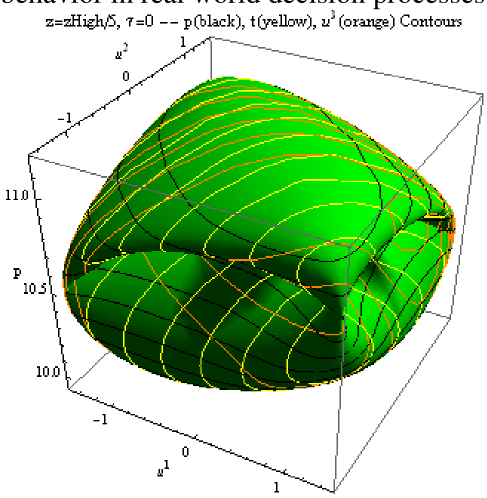

Figure 12-11: ***Decision isobars*** $\{p \quad t \quad u\}$ **versus pressure for fixed** $\{z = 1/10 \quad \tau = 0\}$

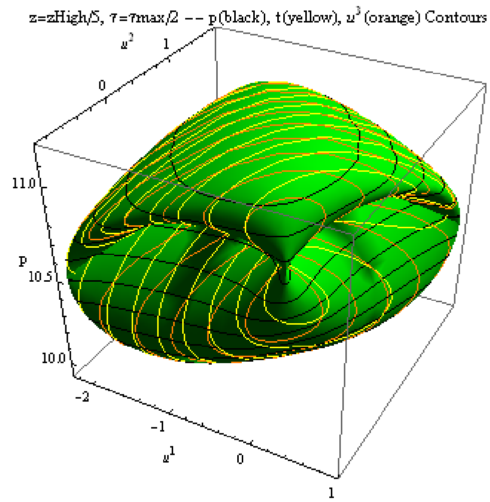

Figure 12-12: ***Decision isobars*** $\{p \quad t \quad u\}$ **versus pressure for fixed** $\{z = 1/10 \quad \tau = 15/2\}$

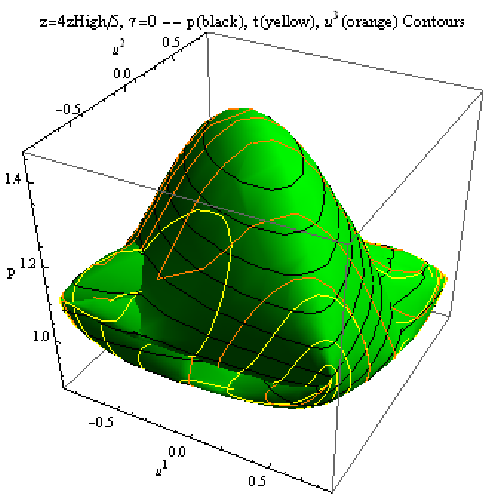

Figure 12-13: ***Decision isobars*** $\{p \quad t \quad u\}$ **versus pressure for fixed** $\{z = 2/5 \quad \tau = 0\}$

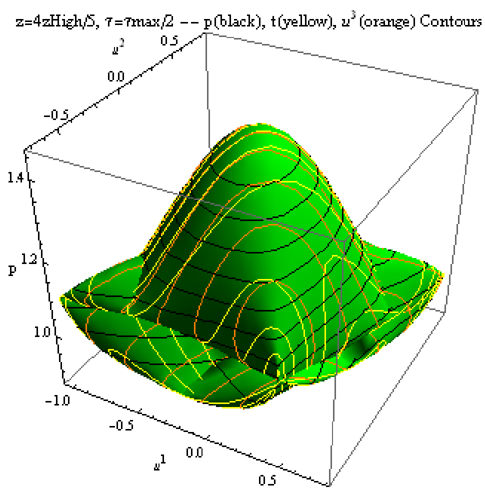

Figure 12-14: ***Decision isobars*** $\{p \quad t \quad u\}$ **versus pressure for fixed** $\{z = 2/5 \quad \tau = 15/2\}$

4. We continue the inquiry of exercise 2 for additional *hidden-in-plain-sight cycles*. We have considered solutions to the *player fixed frame model* in which certain co-moving frame coordinates y^υ are cyclic and exact. One consequence of this is that in the normal-form coordinate basis, the coordinate behaviors are constrained and cyclic (exercise 3). We can investigate this behavior in more detail by considering the surfaces in which one of these coordinates y^υ is constant. This will be a 3-surface in the 4-dimensional space-time of the attack-

defense model. If we choose two such coordinates to be constant, we will get a 2-surface, which is something that we can plot and hence visualize. As examples we choose for the attack-defense model of section 11.9, exercise 2 the 2-surfaces with $x = 0 \quad z = 2/5$ (Figure 12-15) and $y = 0 \quad z = 2/5$ (Figure 12-16). You should be able to identify the streamlines in each plot.

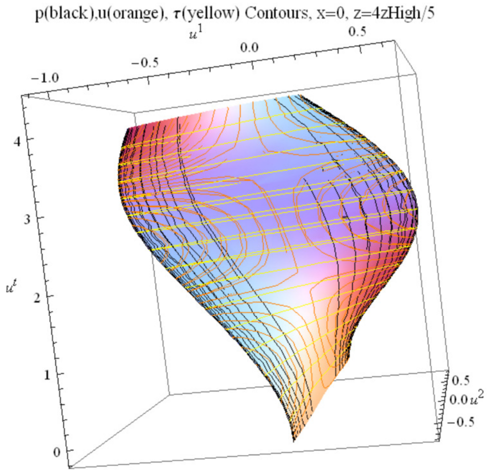

Figure 12-15: 2-surface (defense constant) with $x = 0 \quad z = 2/5$ showing pressure and proper time contours

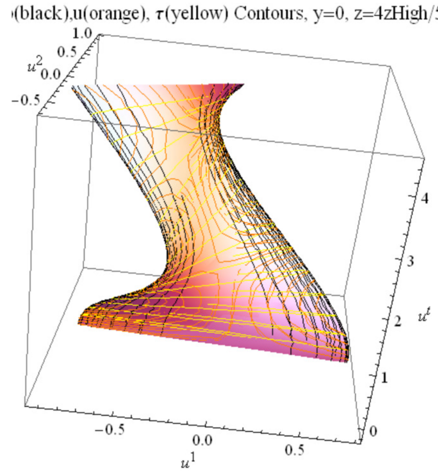

Figure 12-16: 2-surface (attack constant) with $y = 0 \quad z = 2/5$ showing pressure and proper time contours