Chapter 17

Dagen H: Coordination

I begin with two models of coordination. In the first, people will coordinate by doing the same thing. In the second, they'll coordinate by doing different things. Though deceptively simple, the two models generate novel insights about the world. The first will help to explain why people within cultures and organizations tend to be the same and also why cultures differ. It will also produce a paradox: coordination produces diversity. A full appreciation of the model may lead a person to be more accepting of difference. The second model will explain how it is that cities function without much central planning. It won't be a full account. It's a model, but it will shed light on how cities organize themselves.

These two models provide an appropriate jumping off point because they touch on several themes and ideas that I will dig into more deeply in later chapters. For example, both models produce *self organization*: patterns at the macro level produced by the interactions of individual agents. This self organization creates greater stability than would be expected randomly, even though random processes will also generate structures. Also, both models will attain equilibria, and we'll be able to show that they do through the use of a *potential function*. For now, think of a potential function as a function that decreases each period until eventually stopping. I cover potential functions in depth later. In these first models, I

refrain from digging deeply into technical details and focus on the bigger picture.

Model 1: Coordination Games

Social scientists sometimes joke that economics is the study of how people make choices and sociology is the study of why we don't really have any choice, why we're bound by social structures to take particular actions. In most settings, our actions depend on a combination of personal motivations and desires and social pressures. What clothes we buy, what we eat, what movies we watch, which house we buy, even who we marry depends partly on our own preferences and partly on the opinions and wishes of others. In this first model, I am going to start out by assuming that social pressures determine how we act in a particular setting.

I'll start with an example. When you meet someone, do you shake hands, bow, bump fists, hug, or kiss each other on the cheek? How you answer that question correlates with where you live and the identity of your parents. I will argue that no one of these ways of greeting is inherently any better than any other. Shaking is quick but it also spreads germs from hand to hand. Kissing on the cheek is warm and fuzzy but meeting a group of friends gives you a melange of other people's saliva on your cheek. To model this decision, I'm going to construct a game called *pure coordination*. In this game, Cal and Sam meet on the street. They have to decide, do we hug or do we bow. The table below gives the *actions* and *payoffs* to Cal and Sam. Sam's actions and payoffs are in **bold** type.

Pure Coordination

Cal

	Actions	Hug	Bow
Sam	**Hug**	**1**,1	**0**,0
	Bow	**0**,0	**1**,1

If both Sam and Cal choose to hug one another, each gets a payoff of one. If they both choose to bow, then each gets a payoff of one. If they choose the opposite actions, each gets a payoff of zero. The good outcomes to this game involve both Sam and Cal choosing the same action. It doesn't matter which action. They could hug. They could bow. They just both want to do the same thing.

Before, I go any further, I need to take a brief detour and explain the concept of payoffs. Many of the models in this book apply to purposeful actors like people, governments, and organizations. The actors have goals, ambitions, and purposes. To capture those desires, I will use payoffs. For people, these payoffs could represent what economist and philosopher's call utility. For a business, payoff could represent market share or profits, and for a government or political candidate, payoff could represent the level of popular support received. In each case, I will assume that the actors want to maximize their payoffs. This does not mean that I am assuming people are self serving egoists. A person's payoff function could well depend on the happiness of others. That's fine. Mine do. What I need, though, in order to write a model, is a way of capturing how much actors desire various ends and payoffs offer a way to do that.

We now want to take this pure coordination model and expand it in three directions. First, I'm going to embed Cal and Sam in a larger community of people. These could be members of a family, an organization, or a city. I'm going to assume that all of the people in this community meet in pairs and play the pure coordination game. Second, I'm going to assume that there are many such games. People must also coordinate on whether they cross the street when the don't walk sign is flashing, whether they answer their cell phone

while at dinner, and even where they store their soy sauce and ketchup. Third, I'm going to create multiple communities of people playing these same pure coordination games. To sum up, I know have lots of communities, each with lots of people, and each person playing lots of pure coordination games with the many people in their community. To keep the model simple, I'm going to assume that each of those pure coordination games involves only two people, even though some of the games may require more than pairs to coordinate.

Let's set the model loose and let it run. How do we do that? We have three options. We can do formal mathematics. (I'll do that later when I cover potential functions.) We can write a computer program of the model. Or we can just think through the logic. The third approach, though easiest, is prone to mistakes, but we'll take our chances since this is an easy model. I'll assume that there are twenty-six games, one for each letter of the alphabet, and that in each game there exists a capital action and a small action. In this way, I can write down the actions of an agent as the alphabet with some of the letters capitalized. Cal and Sam might start out as follows:

Cal aBcDEfghIJkLMNOpqrsTUvWXyz

Sam ABcdefGhIjklMnOpQRsTUvwXyZ

Notice that they match in some games but not in others. Over time though, what we should expect to happen (later in the book, we'll see how that can happen) is that Cal and Sam and everyone in their community should figure out how to coordinate in each game. Eventually, Cal and Sam should both look the same. We can call this the *CalSam Solution*.

CalSam Soluton ABcdEfghIjkLMNopQRsTuvwXyz

Some of the actions in the CalSam solution agree with Cal's initial action (for example, E does), some agree with Sam (A), and some agree with neither of their initial choice (o).

This last case can arise if other people in the community were taking action o and Cal and Sam switched actions to match these other people.

Let's consider one of the other communities. The people in this community also want to coordinate with one another. When two of them, say Don and Bob, meet, they want to greet each other in the same way. In fact, just like Cal and Sam, they want to coordinate in all twenty-six games. Let's call the solution reached in this community the DonBob solution.

DonBob Soluton aBcDEfGhIjKLmnoPqRSTuUVWyZ

Don and Bob don't interact with Cal and Sam. Don and Bob don't care whether Cal and Sam kiss, hug, bow, or take off their shoes and touch toes. Don and Bob only care about coordinating with one another. Therefore, the DonBob solution will be independent of the SamCal solution, unless of course there's a real health reason for refrigerating soy sauce in which case, that interaction no longer creates a pure coordination game.

Let's take stock of what we've learned so far. We first recognized that in some contexts, people care more about coordinating on actions than on the actions themselves. We modeled these interactions as twenty six pure coordination game. We then found that if one person randomly changes to match another person, then the process creates a random walk with an absorbing barrier. This means that eventually, the process will converge.

The model (1) explains how people can coordinate (2) that getting those last few stragglers to coordinate could take a while and (3) that difference across communities, organizations, and nations that appear intrinsic may be just the result of attempts to coordinate. The people in Italy kiss each other on the cheek when they meet, they eat dinner very late at night, and have small glasses of wine. In America, people shake hands, eat dinner early, and drink large glasses of wine.

This model provides lots of room for interpretive thought (see for example the epilogue to

my book *The Difference*.) and can be extended in several interesting ways. Here I describe two extensions, one due to my colleague Robert Axelrod, the other due to my wife, Jenna Bednar

Inefficient Coordination

t's fun to think about why some people might store ketchup in the cupboard or not wear shoes in their homes, but these interactions are not that important to our overall well being so long as we coordinated. What I want to do next is argue that it is possible to coordinate on efficient actions. To make this point, I am going to rely on some simple game theory. If you pick up a textbook on game theory you will most likely find that it describes its subject matter as the study of interactions between rational strategic actors. Textbooks are snapshots of dynamic fields and as a result, they often describe what was thought as opposed to what is currently thought. The foundations of game theory are no exception. Game theory is now also used to study populations of evolving, adaptive agents who need not be strategic. Therefore, it may be more accurate to say that game theory is the study of environments in which the payoffs to one agent depend on the actions of others and in which there is selective pressures toward actions with better payoffs. If this seems to you like it should always be true, you're right. The question is, when is the effect large enough to go through the hassle of including game theoretic intuitions into our thinking.

Game theory can be used to predict outcomes, explain behavior, and design institutions. Here, I employ game theory to show how interactions can create and dampen diversity. I begin with a simple game that I call the Maui–Des Moines game. In the Maui-Des Moines Game, two newlyweds, Colleen and Rowland, get separated at the airport. Each must buy a ticket on one of two planes. One plane goes to Maui. The other goes to Des Moines. If both choose Maui, they will spend a week long vacation in Maui. If both choose, Des Moines,

they both get a week long vacation in Des Moines. If they choose distinct locations, they spend their vacations apart. We can summarize the happiness or utility that each of the newlyweds gets as follows. If the both choose, Maui, each gets a utility of ten. If both choose Des Moines, each gets a utility of one. If they choose opposite locations, each gets a utility of zero. We can summarize this in a game matrix. The first number in each box denotes Rowland's utility. The second number denotes Colleen's utility. So, for example, the box in the upper left hand corner denotes the outcome where both choose Maui and get utility of one hundred.

Maui-Des Moines

Colleen

Rowland	**Actions**	**Maui**	**Des Moines**
	Maui	10,10	0,0
	Des Moines	0,0	1,1

Given these payoffs, we would expect that both Colleen and Rowland choose to go to Maui. But it is also the case that if each of them thought that the other would pick Des Moines, then they should both pick Des Moines.[1] This sort of thing happens in real life quite often. I know several cases where two people continue to meet at a particular restaurant on a regular basis even though neither one likes it much anymore.

The Maui-Des Moines game is not that interesting except when the two people both choose Des Moines. I introduce it to establish some intuiting for the what I call the Greetings game. In the Greetings game, two people meet and must decide whether to shake or bow. This is a variant of the fourth of the five questions that began this lecture: "when you greet

[1] I am ignoring the mixed strategy equilibria in this and other examples because they are unstable and would not arise in an evolutionary environment.

a friends, do you hug them?" If both players shake hands, each gets a utility of a, which I assume to be greater than zero. If both bow, each gets a utility of one. If they take opposite actions, each gets a utility of zero. These utilities can be summarized in a game matrix as follows:

Greetings

		Colleen	
	Actions	**Shake**	**Bow**
Rowland	**Shake**	a,a	0,0
	Bow	0,0	1,1

This game is similar to the Maui-Des Moines game. Notice that If I set $a = 100$, then this is exactly the Maui-Des Moines game. Not surprisingly, like the Maui-Des Moines game, this game has two stable outcomes: either both people bow or both people shake hands. To predict which outcome is most likely to occur, we would need to know exactly how big a is.

We can use this simple game to help us understand both cultural differences and inefficiency. Consider the fact that people from Eastern cultures are more likely to bow, and that people from Western cultures are more likely to shake hands. We could go through the exercise of trying to make a genetic or environmental case for why a might differ in Eastern and Western Societies. If we were able to show that a is large for Western Societies and small for Eastern societies, then we might have a cultural explanation. We might do this by listing the advantages and disadvantages of each greeting. When bowing, you don't have to touch the other person. This allows people who may find one another physically unclean to greet one another. Bowers can also vary the speed, depth, and gracefulness of the bow to indicate friendship, concern, anger, or exasperation. But, bowing has a down side. It can strain your back and it is not provides for a limited range of emotional expressiveness.

Shaking hands has the advantage that you can vary their duration and strength. Shakes can be vigorous or slow moving. They allow people to be more expressive because they enable the participants to look one another in the eye.

This exercise may seem a bit silly, but let me relate it back to the discussion in the previous lecture on dimensions of culture. Of Hoftsmede's four dimensions of culture, the Power of Authority dimension seems most applicable to the greeting environment. Bowing in Karate and other martial arts is a sign of respect. Members of a society that places more emphasis on power relations would be expected to have a lower value of a. Shaking hands would be less appealing, if for now other reason that it encourages eye contact, something that many people in high those societies might wish to avoid. In Western Cultures bowing has more of a religious significance. The practice of bowing down in worship of someone and warnings of bowing down before false gods can be found in both the old and the new testament.

Thus, one explanation for the differences between how members of Eastern and Western Cultures greet one another could be differences in preferences. Easterners get relatively higher utility from bowing, so they are more likely coordinate on that action. Notice that the argument is not based on genetics necessarily but on induced preferences. Given their set of experiences, people in Eastern societies, they are more comfortable bowing. Given their set of experiences, people in Western Societies are more comfortable shaking hands and do so.

To be honest, I find this line of argument both forced and bordering on circular. It would be entirely circular if the story was that people from Western cultures shake hands because they are from Western cultures. Instead, the argument says, people in Western cultures are low on the Power-Authority dimension and this makes them more likely to shake hands. While not quite circular, the distance from assumption to conclusion is rather short. The argument is forced in that bowing and shaking are interpreted after the fact. If it so happened

that Easterner shook hands and Westerners bowed, then we would be able to interpret each of these actions as equally representative of their respective cultures. While it is true that bowing maintains greater distance between two people, it also takes more effort. To spin this as a greater form of mutual respect does not strike me as that difficult.

Therefore, I am willing to hazard that in almost any society, with some notable exceptions that I will discuss in a moment, that a is close to one. Given that the genetic case for either action is weak, I believe that it is pure chance that Easterners bow and Westerners shake hands. Further, one reason that we do not see much variation within geographic regions of the globe, such as say "those crazy bowing Portuguese" is that due to trade, war, and migrations, similar patterns of behavior were likely to emerge within geographic regions. As in the linear network version of the ketchup model, we are likely to see geographic concentrations of each action.

Now, I want to turn to the exception. Societies for which a is not close to one: societies in which some members have a disease that is passed most easily through physical contact. Since bowing would reduce the spread of this disease, bowing would be preferred over shaking hands because a would be close to zero. Sometimes, when I see people getting off a plane and hugging their friends and relatives, I think of the exchange of germs. In effect, these people are saying to the people that they love the most: "here is a sample of many of the viruses and germs of the people who were on my flight or were in the city I just game from." It is not a very appealling thought. And yet, when I return home from a trip, I hug my wife and children. I don't bow to them, or better yet, I do not wash my clothes and take a shower prior to greeting them.

Before leaving the Greetings game, I want to suppose for the sake of argument that scientists at the Center for Disease Control discovered that shaking hands is the primary cause for the spread of flu viruses. With this new information, the value of the parameter a would fall and the hand shaking equilibrium would be less attractive. Would we the stop

shaking hands?

The fact that the hand shaking equilibrium becomes less attractive does not mean that people would abandon it. Since almost everyone shakes hands, if you began bowing, you might encounter some odd negative reactions. The Greetings game differs from the Maui-Des Moines game and the ketchup model in that each person plays it with many other people each day. If a newspaper article suggested that storing ketchup in the cupboard was dangerous, families would switch because doing so would be easy. Coordinating on something new is not so easy when play a game with dozens of different people each day. If you and a friend were the only two people who played the Greetings game, then as soon as a fell below one, the two of you could chat and decide "based on the medical evidence, we should bow." However, having that conversation with everyone you are likely to meet would be an onerous task. Someone would have to take out an ad or there would have to be a public signal such as a message from the President that we should now all bow not shake.[2]

Consider the case of our use of the English systems of weights and measures. We all want to coordinate on a common set of weights and measures. And, within countries that has mostly occurred. The United States relies on the English system of weights and measures, and most of the rest of the world uses the metric system. So long as there is little trade, there is little reason for people within the United States to change. However, as the trade has increased, the pressure for the United States to change systems has increased, a point I return to later. Two hundred years ago the utilities from using the metric and English systems might have been about the same, but now we would get much higher utility were we to use the metric system. However, given that everyone else in the United States uses the English systems, it is difficult to engineer a switch. We have been able to make the switch on some things like food products but we have been less successful on things like speed limits, or heights and weights, etc. . . .

[2]See Michael Chwe's book on common knowledge.