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DISCUSSION: HAMPTON ON FREE RIDING

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INTRODUCTION

Jean Hampton has argued[1] that an important case of the free-rider problem has the structure of a battle-of-the-sexes game, rather than the Prisoner's Dilemma, as is often assumed. This case occurs when the collective good[2] to be produced is a 'step' or 'lumpy' good, one that is produced in a single production step. Battle of the Sexes is a coordination game, with stronger equilibria than games such as the Prisoner's Dilemma or Chicken. Hampton argues that, because of this difference, there is good reason to think that players facing a battle-of-the-sexes game can more easily reach mutually desirable outcomes than players facing these other games. An examination of Hampton's argument, however, shows that she has failed to specify a condition that would clearly distinguish her examples of battle-of-the-sexes games from chicken games. Consequently, Hampton's claim that free riding in the provision of step goods is less tempting than other analyses have suggested because of the presence of coordination equilibria is incorrect as it stands.

I wish to thank the editors and the anonymous referees for their suggestions. Any remaining errors are my responsibility.

[1] Hampton (1986); Hampton (1987).

[2] Hampton uses 'collective' and 'public' interchangeably in (Hampton 1987). A collective (or public) good is one that is indivisible and non-excludable. See, for example, Taylor (1976) for a discussion.

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HUME'S EXAMPLE

Hampton uses an example from Hume as a paradigm of the free-rider problem in the production of a collective, step good:

> Two neighbours may agree to drain a meadow, which they possess in common . . . But 'tis very difficult, and indeed impossible, that a thousand persons shou'd agree in any such action; it being difficult for them to concert so complicated a design, and still more difficult for them to execute it; while each seeks a pretext to free himself of the trouble and expense, and wou'd lay the whole burden on others. (Hume 1978, p. 538)

To make the example more rigorous, Hampton specifies six conditions that capture the spirit of the example, and I will summarize them here. First, draining the meadow is a collective good. Second, it is a step good. Once the drained meadow is created, it is a good that is not incrementally increased in either quality or quantity by further efforts. Third, individual preferences for producing the good are common knowledge[3] among those who share the meadow. Fourth, there is no person in the group for whom the individual benefit of the good is great enough to outweigh the cost of that person single-handedly draining the meadow. Fifth, the costs of draining the meadow can be divided among the group in a variety of ways, but the minimum number of persons needed to drain the meadow is two. Sixth, and finally, costs incurred by individuals towards the creation of the good cannot be recouped before the meadow is drained.[4]

Hampton notes that Hume's people face two separate problems: determining how many persons will work to produce the good *and* the identity of these persons, if the number determined is less than the whole group. Hampton proceeds to analyze this situation using a three-person model as a manageable, yet accurate, simplification of the 1000-person case. What is the game-theoretic structure faced by three such persons? Hampton begins her analysis with:

> Clearly each player would most prefer the outcome in which the other two players drain the meadow and she languishes at home, eventually enjoying the good produced at no cost to her. Next best is the situation where all of them share the work to be done, which is better than the situation where she and only one other player split the work between them (doing half of the work is worse than doing a third of it). But this option is substantially better than the situation in which the meadow isn't drained because none of them or only one of them is willing to do it, and of course the worst situation for each of them is where she puts in work almost equal to the benefit to be received from the good to be produced, but is never assisted by anyone else,

[3] The costs and benefits of the good to each person are known, and each person knows that the others know, and know that they each know, etc.

[4] Hampton (1987, p. 251).

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		Person B	
		P	∼P
Person A	P	1,2	3,3
	∼P	3,3	2,1

FIGURE 1

> so that the good never gets produced and she loses whatever resources she put into the attempt to produce it. (Hampton 1987)

Hampton claims that, given these preferences, the game the players face is Battle of the Sexes.[5] Hampton does not provide a matrix for the game matching Hume's example in Hampton (1987), but instead refers the reader to page 151 of Hampton (1986) where she presents a matrix description of a three-person battle-of-the-sexes game. In Hampton (1987), Hampton provides the matrix for a *two*-person game for illustrative purposes. The content of that matrix is reproduced here as Figure 1.[6] The game in Figure 1 has two Nash equilibria in pure strategies.[7] Given that the other player will take action P (or ∼P), then action P (or ∼P) is the 'best reply' for the first player to take. Both players prefer to *coordinate* their actions, so that each prefers that both do action P or action ∼P over the other two alternatives. Indeed, the two equilibria are stronger than Nash equilibrium requires. Not only can a single player not improve her own position with a different action (a move, 'away' from her best reply), but she could not be made better off by a different action from the other player (or any one player, in a larger game). Nash equilibria meeting this additional condition are called 'coordination equilibria',[8] and games where such equilibria predominate are referred to as 'coordination games'.

A battle-of-the-sexes game is, thus, a coordination game, unlike such games as the Prisoner's Dilemma and Chicken that do not have coordination equilibria.[9] This is the major point of Hampton's argument,

[5] See, for example, Luce and Raiffa (1957, pp. 90–4) for a discussion of the battle-of-the-sexes game.

[6] In Figures 1 through 5, numbers in the cells are ordinal rankings; Nash equilibria are shown with one underline, and coordination equilibria with a double underline.

[7] See, for example, Gibbons (1992, p. 8).

[8] Lewis (1969, p. 14).

[9] There is some conflict of interest present in a battle-of-the-sexes game. Referring to Figure 1, Person A would prefer the players coordinate on action P over action ∼P, while Person B would prefer coordination on action ∼P over action P. Thus, it is not a game of 'pure' coordination. Nevertheless, coordination is preferred by both to failure to coordinate.

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regarding in particular the free-rider problem for step goods. Hampton refers to the common analysis of free-rider problems using the Prisoner's Dilemma as incorrect. In this, she is simply agreeing with Taylor and Ward (1982). In addition, however, she contests the characterization in Taylor and Ward (1982) of the free-rider problem in the provision of step goods as a chicken game. Hampton states:

> There is a big difference between the game of chicken, which is a game of conflict, and the battle-of-the-sexes dilemma, which is a type of coordination game with some conflict of interest. The former has only Nash equilibria. The latter has coordination equilibria; and whereas the former poses the question, 'Do we cooperate?', the latter poses the question, 'How do we cooperate?' (Hampton 1987, p. 254, n. 7)

Hampton also relies on this point in her detailed reconstruction of Hobbes' argument for the state in Hampton (1986). Although Hampton argues that Hobbes ultimately fails in his direct argument for the state, she claims that Hobbes can sidestep some forms of criticism because he relies on a game with the structure of Battle of the Sexes, rather than, say, Prisoner's Dilemma.[10] Hampton argues that in attempting to institute the sovereign, Hobbesian people face a battle-of-the-sexes game, in which the issue is one of *how* to cooperate, rather than *whether* to cooperate. Here again, Hampton introduces Hume's meadow draining example as a paradigm of the free-rider problem that Hobbesian people face. Hampton provides a matrix description of the three-person version of meadow-draining game on page 178 of Hampton (1986), although one necessarily different from the battle-of-the-sexes matrix on page 151. The players in the battle-of-the-sexes matrix face a choice among three alternatives (much as the players in a two-person battle-of-the-sexes game choose among two), Hume's meadow drainers have only two options: to drain or not.

THE PROBLEM

The content of Hampton's three-person meadow-draining matrix is reproduced here as Figure 2. The reader can verify by inspection that this matrix correctly captures the preferences (given in the first Hampton quote above) that Hampton describes for the three-person meadow draining game. The problem is that inspection also shows that this game is not an example of a battle-of-the-sexes game. There are indeed three equilibria corresponding to the three equilibria of a three-person battle-of-the-sexes game. These occur, as expected, where two players work to drain the meadow and one player does not, thereby free riding on the efforts of the others. However, unlike a battle-of-the-sexes game, these equilibria

[10] Hampton (1986, Section 6.9).

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		Persons B;C			
		P;P	P;∼P	∼P;∼P	∼P;P
Person A	P	2,2,2	3,3,1	5,4,4	3,1,3
	∼P	1,3,3	4,5,4	4,4,4	4,4,5

FIGURE 2

		Persons B;C			
		S;S	S;∼S	∼S;∼S	∼S;S
Person A	S	2,2,2	3,3,1	2,4,4	3,1,3
	∼S	1,3,3	4,2,4	4,4,4	4,4,2

FIGURE 3

are not coordination equilibria. This is because the case in which all three players work to drain the meadow is the second-preferred outcome by each player. Thus, from any one of these three Nash equilibria, a player (indeed, two players) could be made better off by a change in the move of one player (the free rider deciding to help out, rather than free ride). What game, then, are the would-be meadow drainers facing?

Consider the game of chicken. The usual 'story' behind the chicken game[11] is a situation in which two teenaged drivers race their cars towards each other. A player who turns away, or swerves, is labeled a 'chicken'. It is assumed that the drivers believe that the best outcome is to hold steady while the other driver swerves. The second best outcome for both players is for both players to swerve. Being the only 'chicken' is the third best alternative. The worst case is when neither driver swerves.

Figure 3 presents a three-person chicken game, with the assumption that a crash will occur if any two (or more) drivers fail to swerve. Since more than two players are involved, it is additionally assumed that swerving when there will be a crash is equally preferred to swerving when all swerve, but is less preferable than not swerving when there will be no crash. (There is no 'shame' in swerving when there will be a crash, but not swerving is

[11] Also called the 'Hawk/Dove' game in the evolutionary biology literature. See, for example, Dawkins (1976).

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		Persons B;C			
		S;S	S;H	H;H	H;S
Person A	S	1,1,1	3,3,2	3,2,2	3,2,3
	H	2,3,3	2,3,2	2,2,2	2,2,3

FIGURE 4

always preferred to swerving when there will not be a crash.) Comparing Figures 2 and 3, these games are very similar in their structure. There are different preference rankings in only three of the eight possible outcomes. Comparing (P,~P,~P) with (S,~S,~S), for example, we see that the corresponding preference rankings are (5,4,4) and (2,4,4). Paying in the meadow game when no one else does means that one's resources are simply wasted. This is the worst possible outcome. In a chicken game, however, swerving when no one else does is the second-highest ranked outcome. One result of this difference is that the game of Figure 2 has an additional equilibrium, (~P,~P,~P), in which no one pays the cost of draining the meadow. Interestingly, this outcome is a coordination equilibrium, although it is less preferred by *all* than *any* of the three Nash equilibria.

The presence of this coordination equilibrium might suggest[12] that the game of Figure 2 is a version of the Stag Hunt Game (so named due to a passage in Rousseau's *A Discourse on Inequality*). In this 'story', each member of a group of hunters has the choice of hunting stag or hare. Successfully hunting a stag requires the cooperation of all of the hunters, while any hunter can catch a hare without help from the others. Each hunter would prefer catching a stag to a hare, but each would prefer catching a hare to catching nothing. A three-person Stag Hunt is presented in Figure 4.[13]

Both Figure 2 and Figure 4 have coordination equilibria at their respective mutual non-cooperation points, and both have other equilibria that all prefer over mutual non-cooperation. One difference is that Figure 2 has three such points, while Figure 4 can only have one, since the cooperation of all hunters is a stipulated requirement. However, it could be

[12] This alternative was pointed out to me by one of the editors.

[13] Figure 4 assumes that the payoff for catching a hare is not affected by the number of hunters who try to catch one. The story of the Stag Hunt can be told such that it does have an effect, but the assumption of Figure 4 makes (H,H,H) a coordination, not merely a Nash, equilibrium. In turn, this gives a closer correspondence between Figure 2 and Figure 4.

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questioned whether this requirement is an essential feature of a stag-hunt game for more than two players.

In the Prisoner's Dilemma, the dilemma is that following an individually rational strategy does not produce a Pareto optimal outcome. In the Stag Hunt, a dilemma does not arise from individuals acting rationally, but rather from a concern that some of them might not do so. The difficulty comes from the realization that, especially in a large group, some hunter might be tempted to take a 'hare in the hand', thereby wasting the efforts of the cooperators. Hunters may begin to reason, 'If some other hunter *might* stop to catch a hare, then, perhaps, I *ought* to do so'.[14] For Stag Hunt to serve as a model for the game of Figure 2, however, we must assume the captured stag will be enjoyed by all the hunters, even if only a subset has captured it. Hence, the situation where all hunters cooperate will no longer be an equilibrium. Now, the special difficulty in Figure 2 is not that one or more of the players might fail to act rationally, but that they have no way to coordinate which of several equilibria, each superior to mutual non-cooperation, to settle on. The Chicken story illustrates the need for some mechanism for making a particular equilibrium salient, and that is the problem faced by the players in Figure 2.

Finally, Hampton argues that coordination games present a better chance for cooperation, but Figure 2 cannot reasonably be called a game in which coordination equilibria predominate. Based upon these considerations, I claim that Figure 2 is best considered a kind of chicken game. Consequently, Hampton was too quick to claim that Taylor and Ward had erred by focusing on chicken games in the provision of collective step goods.

If the outcome (P,P,P) of Figure 2 were ranked third (or less) by the players, the three Nash equilibria would be coordination equilibria, and it would be reasonable to call the resulting game a coordination game like Battle of the Sexes. No doubt, examples that fit this situation can be constructed, but I will not attempt to do so here. Another way to 'restore' the game of Figure 2 to a battle-of-the-sexes game would be if the outcome (P,P,P) were ruled out as a possibility in some way. Although such a move requires an additional condition beyond the six given by Hampton as characterizing the free-rider problem in the provision of a collective, step good, I believe that Hampton had implicitly assumed such a condition. This can be illustrated by examining an example taken from Hampton (1986) that she used in connection with the free-rider problem. Following that, I will explore a second example also from Hampton (1986) in which such an extra condition plays a role. In the first example, the additional condition gives a battle-of-the-sexes game. However, in the second, while

[14] Hofstadter (1985, ch. 30) refers to a game with the structure of Stag Hunt as having 'reverberant doubt'.

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		Persons B;C			
		R;R	R;∼R	∼R;∼R	∼R;R
Person A	R	3,3,3	2,2,1	3,3,3	2,2,1
	∼R	1,2,2	3,3,3	3,3,3	3,3,3

FIGURE 5

the game transformed by the new condition is a coordination game (unlike Chicken), it is Stag Hunt, not Battle of the Sexes.

THE ESCAPING SOLDIERS

The first is the 'Escaping Soldiers' example, which Hampton presents in order to demonstrate the likelihood of players being able to reach an equilibrium outcome in a battle-of-the-sexes game (1986, pp. 158–9). In this example, ten American soldiers are trying to escape being killed by Nazi soldiers. The fleeing Americans find a rowboat to take them to safety in nearby Switzerland. The collective good is the use of the boat to provide safety on the neutral shore. The coordination problem that the Americans must solve is which soldiers will row the boat and which will huddle in the bottom of it. Each soldier clearly prefers escaping in the boat to being left behind, but the pair who must row the boat will be more exposed to sniper fire than those with their heads down.

Since as few as three escaping soldiers would also face a coordination problem, for simplicity in presentation I will reduce the number of American soldiers from ten to three, and this case is presented in Figure 5. It is assumed that three soldiers attempting to row would lead to confusion such that the boat would not leave the shore; alternatively, the outcome where all three soldiers row at once is ruled out, since it is physically impossible: the boat has only two oars. Further, it is assumed that the boat goes nowhere unless two soldiers are rowing. On these assumptions, Figure 5 has three coordination equilibria, one for each soldier who does not row.[15] Thus, the matrix in Figure 5 bids fair to be called a battle-of-the-sexes game.

The difference between Figure 2 and Figure 5 is that there is no way in Escaping Soldiers for the cost of escaping to be borne successfully by all three players. If another oar were available in the boat, it would be the matrix of Figure 2 and not Figure 5 that represented the game faced by the soldiers. The possibility that all players can share in the work converts

[15] Plus an additional coordination equilibrium where no one rows.

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the game from a battle-of-the-sexes game to a chicken game. In order to have a battle-of-the-sexes problem in the provision of a collective step good, the condition that not all the players can share in the work must be added to Hampton's original six requirements.

THE HOBBESIAN POSSE

The second example plays a key role in Hampton's reconstruction of Hobbes' argument. Hampton writes:

> Suppose that the inhabitants of the state of nature have determined that they need and want a sovereign to end their mutual warfare and have elected a sovereign. This sovereign then proceeds to issue a variety of orders backed by threats, among them an order not to steal another's possessions. Nevertheless, an individual we shall call Joe the Desperado seizes many valuable possessions from one of the subjects of this newly formed commonwealth and heads off into the sunset. The sovereign-elect then calls on her subjects to give her the power to enforce her threat against Joe: 'It will take a posse of six people to bring back Joe dead or alive. I have arrived at that number by determining the minimum number of people required to overpower Joe so that the danger to each of them is less than the dangers they would face as individuals in the state of nature from attack by any of their fellows in this state. So I hereby order *you six* [she fingers them] to capture Joe, bring him back here for trial before me, and punish him as I specify if I find him guilty.' (1986, pp. 176–7)

The assumption here is that a posse of the proper size faces less risk of harm in subduing Joe than the individuals in such a posse would face in a state of nature without the presence of a sovereign. For each to obey the sovereign-elect – and thereby legitimate the position of the sovereign – is preferred by each to failing to form the posse – thereby failing to ratify the decision of the sovereign-elect and so remain in the state of nature. Relying on her analysis of the meadow draining example, Hampton asserts that the game faced by the 'fingered six' is a battle-of-the-sexes game. As we have seen, however, this example, represented by Figure 2, is not a battle-of-the-sexes game, but a chicken game. Nevertheless, it could be that Hampton has correctly identified the game faced by the posse as a battle-of-the-sexes game. The Escaping Soldiers face a battle-of-the-sexes game because of a physical constraint (only two oars). The corresponding constraint faced by the Hobbesian Posse is the sovereign's determination that six persons is the necessary size for the posse.

Unfortunately, this determination of the posse size is not quite as definite as finding only two oars in a boat, nor is it an easy number to select. If the posse is too small, the risk faced by the members is greater than what each faces in the state of nature. If the argument is to provide an adequate justification for obeying the sovereign's orders, thereby leaving

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the state of nature, the number selected must not be too small, nor can it be too large. Should the posse members believe (or come to believe) that a proper subset of their number could subdue Joe at less risk to each than what is posed by remaining in the state of nature, the game is that of Figure 2. The possibility that one or more members of the original posse *could* join the subset (thereby reducing the risk even further) creates a chicken game, not Battle of the Sexes.

Further, the game is not properly a battle-of-the-sexes game *even if* the sovereign has correctly chosen the size of the posse. By assumption, one fewer person would cause the posse to fail in its purpose, and each person prefers the success of the posse to its failure. The worst case is to be part of an inadequate posse: by assumption, the risk of facing Joe in such a posse is worse than the state of nature. Hence the equilibria are where everyone picked by the sovereign-elect joins the posse or no one does, but *everyone* prefers the first equilibrium to the second. As discussed above, this describes Stag Hunt[16], not Battle of the Sexes (where the players do *not* all agree that one equilibrium is better than another).

CONCLUSION

Battle of the Sexes can play a role in understanding the provision of collective, step goods, as shown by Escaping Soldiers, but Hampton's six conditions by themselves do not actually specify a battle-of-the-sexes game. Unless the number of players who could be involved in the production of the good is restricted by some obvious limit, players under the six conditions face a chicken game. In addition, when the limit is present, the resulting game could be either Battle of the Sexes or Stag Hunt.

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[16] I am indebted to an anonymous referee for pointing out the proper label for this game situation.

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